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NATURE AND REASON

HARMONIZED

IN THE

PRACTICE OF HUSBANDRY.

BY THE LATE JOHN LORAIN.

WITH AN ALPHABETICAL INDEX.

PHILADELPHIA:

H. C. CAREY & I. LEA—CHESNUT STREET.

1825.

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Eastern District of Pennsylvania, to wit:

SEAL. BE IT REMEMBERED, that on the twenty-fourth day of January, in the forty-ninth year of the Independence of the United States of America, A. D. 1825, Martha Lorain, of the said District, hath deposited in this office the title of a Book, the right whereof she claims as Proprietor, in the words following, to wit:

"Nature and Reason harmonized in the Practice of Husbandry. By the "late John Lorain. With an alphabetical Index."

In conformity to the Act of the Congress of the United States, entitled, "An Act for the encouragement of Learning, by securing the copies of Maps, Charts, and Books, to the Authors and Proprietors of such copies, during the times therein mentioned." And also to an Act, entitled, "an Act supplementary to an Act, entitled, 'an Act for the encouragement of Learning, by securing the Copies of Maps, Charts, and Books, to the Authors and Proprietors of such copies, during the times therein mentioned,' and extending the benefits thereof to the Arts of designing, engraving, and etching historical and other prints."

D. CALDWELL,
Clerk of the Eastern District of Pennsylvania.

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BOOK I.

ON MANURES AND VEGETATION.

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CHAPTER I.

Of the action of lime in its caustic state. Also, that of the carbonate of lime, marl, and powdered limestone, considered.

A SUFFICIENCY of lime, to answer every purpose in the economy of plants and animals, exists in animated nature, and is intimately blended with all soils, whether they be calcareous, or otherwise. Very erroneous theories have been propagated, in consequence of not duly considering that substances originating in animal and vegetable matters, may so recede or depart from their original form, that but little, if any, of the properties of the original substance is retained.

Observations on the economy of nature, where calcareous matter abounds.

To understand the nutritious matters on which plants live, we should become acquainted with the vegetable economy, and the analogy between plants and animals; also, with the means employed by nature to propagate animal and vegetable life, to the utmost extent, where she presides uncontrolled by man. Therefore, the consideration of these subjects will be connected with my explanation of the nature and properties of manures, and the best methods to be used in gathering, preserving, applying, and keeping them from useless waste, after they have been applied.

I will first draw a line of distinction between those manures which actually enrich the soil, and those that merely excite fertility without producing that effect.

All animal and vegetable substances enrich the soil. No other substances are known to effect this invaluable purpose.

Mechanical manures, such as clay, sand, gravel, &c. when properly applied, promote vegetation by altering the texture of the soil, and do not injure the enriching substances found in it.

The manures which are generally termed stimulating, also promote vegetation, but in doing this, they exhaust the soil: hence it is, that the fertilizing powers of lime and gypsum, will cease to act when they no longer find a sufficiency of animal or vegetable matters in the soil to act upon, and will resume their action, as soon as either of those enriching manures has been applied.

It seems to be generally believed that gypsum assists the decomposition of such animal and vegetable substances, as either from their texture, or from being too thinly scattered through the soil, cannot be decomposed by the less powerful operations of nature or

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art, with sufficient despatch to produce luxuriant vegetation; also, that this substance excites the plants, and increases their capacity for gathering and digesting nutriment.

It is certain that gypsum produces amazing fertility in old worn out soils, where but few traces of animal or vegetable matter appear; likewise, that great debility generally takes place in such soils, in consequence of the exhausting influence of this substance, when proper attention has not been given, to introduce a sufficiency of animal or vegetable matter to counteract the impoverishing effects of this powerful promoter of vegetation.

When this substance was first introduced as a manure, its exhausting properties were not known, and many greatly injured their grounds by the improper use of it; especially those who resided where there was a ready market for hay. This caused loud complaints. They have, however, been nearly silenced, by the practice of those who were careful to return to the ground a reasonable proportion of its product; and the improvement made in the soil, by the judicious use of this substance, almost exceeds credibility.

Since it has been more generally known that gypsum is a very valuable manure for wheat, when the seed is rolled in it, or when that substance is strewed over the surface of the ground, and is either harrowed or ploughed in with the seed,* its exhausting properties are more to be dreaded. If, however, a sufficiency of the product of the soil be returned to it, this practice may prove very beneficial.

Lime is generally applied immediately, or soon after, it is slaked; or if it be suffered to lie long in heap, after it has been slaked, there is reason to believe that it obtains but little carbonic acid until after it is spread over the soil, for mortar will remain long in bulk before it becomes a solid body.

The caustic property of the lime continues to act on the animal and vegetable matter contained in the ground, until the lime becomes perfectly effete. Therefore, this powerful promoter of vegetation greatly exhausts the soil, unless a due proportion of the vegetation excited by it be returned to the land. How lime acts, after it becomes effete, does not seem to be well understood.

It is asserted by Sir H. Davy, that, "Chalk, calcareous marls, and powdered limestone, act merely by forming a useful earthy ingredient in the soil."† It is, however, difficult to conceive how so small a quantity of powdered limestone, as has been successfully used, could produce such valuable effects on vegetation, if it "acts merely by forming a useful earthy ingredient in the soil." It is well known, that water is capable of dissolving most natural

* However useful it may be to harrow in the gypsum, it does not seem likely to produce the same immediate powerful effect, as is obtained by rolling the seed in that substance.

† See his Lec. on Agr. Chem. pages 21 and 22.

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bodies, and of imbibing and conveying their properties; and that the water passing among limestone, partakes of that hard substance. As the effect produced in the animal economy, by the use of the water from our limestone springs, seems to determine its stimulating properties, it is probable that the water in contact with the powdered limestone in the soil, imbibes the calcareous matter in sufficient quantities to produce valuable effects on vegetation.

Dr. Darwin observes, "lime, in its pure state, is soluble in about 600 times its weight of water; and by greater quantities of carbonic acid than are necessary for its crystallization, it is soluble in much greater quantities, as appears by the calcareous depositions of the waters at Matlock; and may, I suppose, supply a nutritious substance by uniting with mucilage or oil, either in the earth or at the roots of vegetables, or on the surface of the soil, which may be gradually washed down to them."*

Sir H. Davy tells us, "The acids found in the vegetable kingdom are numerous;"† also, that "the acetic acid, or vinegar, forms soluble salts with alkalies and earths;" and "the malic acid forms soluble salts with lime."‡ Likewise, that "the carbonic acid united to lime or magnesia, if any stronger acid happens to be formed in the soil during the fermentation of vegetable matter which will be disengaged from the earths, may be decomposed."§ Also, when "the water used in irrigation has flowed over a calcareous country, it is generally found impregnated with carbonate of lime, and in this state tends in many instances to ameliorate the soil."‖

No fresh vegetable substance is decomposed either within or upon the soil without acid being formed; therefore, the action of the weaker, as well as of the more powerful of these acids on the carbonate of lime, seems to be obvious; especially as water, without the aid of acids, acts slowly on limestone. It should also be recollected, that the surface to be acted upon by either, is greatly increased by reducing the limestone to powder.

It is difficult to believe that the amelioration from water which has flowed over a calcareous country, proceeds merely from its conveying a substance "forming an useful earthy ingredient in the soil." The depositions of the calcareous matter must progress very slowly, and the valuable effects produced in vegetation by the impregnated water quickly appear: the reason seems obvious, for this gentleman, on another occasion, (and when he seems not to have been thinking of the theory now under consideration,) cautions farmers, to avoid the injurious decomposing property of the carbonate of lime, by observing that, "In washing of sheep, the use of the water containing carbonate of lime should be avoided, for this substance *decomposes* the yolk of the wool, which is an animal soap, i. e. a compound of oily matter and potassa, with a little oily matter in excess."¶ Thus

* See his Phil. pages 215 and 216.
† See his Lec. on Agr. Chem. page 106.
‡ Idem, page 108.
§ Idem, page 177.
‖ Idem, page 351.
¶ Idem, pages 369 and 370.

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we see that one fact, substantiated by practice and observation, is generally of much more consequence than a multitude of chemical experiments, resting on theory alone. Yet it clearly appears, that Sir Humphrey must have reasoned on this very interesting fact, no further than wool was concerned; otherwise he would have been better acquainted with the nature and properties of the carbonate of lime. He is not content with asserting, that "Chalk, calcareous marls, and powdered limestone, act merely by forming an useful earthy ingredient in the soil," but also says, "mild lime, powdered limestone, marls, or chalk, prevent the too rapid decomposition of substances already dissolved, but have no tendency to form soluble matters."

But to cast further light on this subject. The value of marl, is generally estimated by the proportion of calcareous matter contained in it; for though the other ingredients, when properly applied, act as mechanical manures, they are bulky and weighty, and will seldom pay for the expense of digging, hauling and spreading, particularly if a proper system of husbandry be pursued.* Marl is in general considered a much more lasting manure than lime: the cause of this is evident, the calcareous matter contained in this compound, is not rendered caustic by calcination, neither is the carbonic acid expelled by that process.

As the calcareous matter and carbonic acid contained in marls, must act on the soil, and also on the growing vegetation in the same way as does powdered limestone, the value of the latter seems to be determined by the very valuable and lasting effects of the former.

Pulverised limestone, at the rate of from eight to ten bushels to the acre, has been tried in this country on grass grounds, and greatly increased the crops.† I have never used lime prepared in this way, but believe it merits more attention than has been given to it. It is also doubtful, whether, under a proper system of management, it will cost more to quarry, haul, pulverise, and apply ten bushels of limestone, (if the stone be pulverised immediately after it is quarried,‡) than it usually costs to burn and apply twenty bushels of lime. The quarrying and hauling in the latter case would be double. The cost of fuel and burning in some situations is considerable.

After having clearly demonstrated (even from Sir Humphrey's own testimony) the decomposing property of the carbonate of lime, it would be useless to say more at present of calcareous matter, were it not that nature has caused it to exist in various forms. Some of the forms in which it appears, seem to be vastly more interesting than others. None, however, would appear more highly important, than that enough of lime to answer every purpose in the

* This will be hereafter explained.

† See Boardley's Husbandry, pages 484 and 485.

‡ Stone is commonly much softer before than after it has been exposed to the influence of the sun and air. It is, of consequence, more readily pulverised or ground.

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economy of plants and animals, exists in animated nature; and is intimately blended with all soils, whether they be called calcareous, or otherwise. This is accomplished by the death and decay of the vegetation grown on them; also, by the dissolution and decomposition of the animalcula, which had subsisted on this vegetation, together with the dung furnished by them, and the larger animals fed on the grounds.

If these very obvious facts had been sufficiently considered by chemists, philosophers, and writers on farming; also, that the further any substance recedes or departs from that in which it has been *supposed* to originate, the less of the properties of the original substance are retained; the agricultural effects produced by many different substances would not have been so often and so egregiously misunderstood. Of consequence, not so often uselessly, and but too frequently ruinously applied.

Doctor Darwin says, "Margraff found that many vegetable matters, particularly farinaceous grains, contain enough of phosphoric acid to produce phosphorus, when exposed to great heat, and that phosphorus has been detected in every kind of vegetable and animal substance;" but "in greater quantity in the parts, and recrements of animals, as in their flesh, dung, urine, and bone ashes, and most copiously in the two latter." After this, he observes, that, "an important question now occurs; if this same simple material phosphorus be not generally made in the vessels of vegetables, whence do they acquire it? They probably obtain it in considerable quantity from the recrements of decaying vegetable and animal bodies, as appears in rotten wood, and in putrefying flesh, bone ashes, and salts of urine. But I suppose there is another source of phosphorus, I mean in calcareous earth, which has also been of animal origin in the early ages of the world." Also, "It would appear, that the immense quantity of limestone in the world, which was originally formed from the shells of sub-marine animals, has, during the long lapse of time, lost more or less of its original phosphoric acid; the carbon having thus slowly decomposed the phosphoric acid in the laboratory of nature, without great heat, as it does in our crucibles in a short time, by the assistance of great heat." Likewise, that "there are many instances given by Mr. Anderson, and Lord Kaimes, of soils which are said to have been for ages uncommonly fertile, without the addition of manures. There are plains near the shore in the county of Caithness, and in the Hebrides, which are said to consist entirely of shells broken into very small particles, without almost any mixture of soil. Now, the soil of an extensive county called Lincoln Heath, I observed, some years ago, to consist, in a great degree, of powdered limestone, which, like the Ketton limestone, appeared in small round particles, which I suppose had, in remote times, been dissolved in water, and again precipitated; which shows a probable difference between this lime, and recent shells, in respect to their antiquity, and, consequently, that the former must certainly contain

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much of the original phosphoric acid, and the latter only carbonic acid. And as Lincoln Heath was then esteemed a very unproductive soil, there is reason to infer that the phosphoric acid in recent shells, is of greatly more service to agriculture, than the carbonic acid of alluvial limestone, or than calcined lime alone. Hence it is probable that a greater quantity of phosphoric acid may exist in some marls than others, as well as in some limestones; thus, the appearance of recent shells exists in the lime near Loughborough, in Leicestershire, and in some marls called shell-marls; which must, therefore, probably contain much more phosphoric acid, so as almost to resemble the bones of animals; and may thus be more friendly to vegetation." This gentleman also observes, "an union of phosphoric acid only with lime, has lately been found to compose whole mountains in Spain, and is now termed phosphate of lime, resembling bone ashes." *

From this reasoning it would appear that Doctor Darwin believed "the immense quantity of limestone in the world was originally formed from the shells of sub-marine animals," and that it had, "during a long lapse of time, lost more or less of its original phosphoric acid: the carbon having slowly decomposed the phosphoric acid." From his remarks on the Lincoln Heath limestone, it would seem he also believed that the carbonic acid in process of time decomposed all the phosphoric acid, and took full possession of the calcareous earth; and that "the phosphoric acid in recent shells, is of greatly more service to agriculture, than the carbonic acid, alluvial limestone, or than calcined lime alone." Also, that some marls contain "much phosphoric acid, so as almost to resemble the bones of animals."

Sir Humphrey Davy tells us, "the bones of an ox are composed

Of decomposable animal matter, . .	51 parts
Phosphate of lime, ...	37.7
Carbonate of lime, ...	10
Phosphate of magnesia, ...	1.3
	100 "†

The bones of several other animals mentioned by him, do not contain as great a proportion of decomposable animal matter as the bones of an ox; but he says, "the bones of the carp contain 50 parts of decomposable animal matter, 45 phosphate of lime, and 5 of carbonate of lime; red coral 46.5 of animal matter, and 53.5 carbonate of lime; articulated coraline, 51 of animal matter, and 49 carbonate of lime; white coral, equal parts of animal matter and carbonate of lime;" and that "the sponges also afford gelatine." ‡

Of the different proportions of decomposable animal matter, in

* See his Philosophy, from page 207 to page 212.
† See his Lec. on Agr. Chem. page 290. ‡ Idem, page 293.

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the different shells of which limestone is formed, I know nothing. It however seems probable that, on an average, they contain quite as much as do the bones of the animals who reside on the earth: consequently, that they afford much food for plants; and that the nutriment contained in them, is more or less valuable as the shells may happen to be more or less recent. Still, after the shells have lost much animal matter, the phosphoric acid contained in them, "may be of greatly more service to agriculture, than the carbonic acid of alluvial limestone." It may act more effectually on the animal matter contained in the shells, and also in the soil, until all this matter be gradually exhausted.

After this has been done, the phosphoric acid, fully combined with the calcareous matter contained in the shells, will form a phosphate of lime, which, being "soluble in water containing any acid," may still continue to be "more friendly to vegetation, than the carbonic acid of the alluvial limestone." * Although it has been proved that the carbonate of lime is slowly dissolved by water alone, and it would seem that water containing any acid will act more powerfully on it than water only, still it may not be as readily decomposed by any acid found in the soil, as is the phosphate of lime. The phosphoric acid combined with lime, may also form a much more powerful compound, than the carbonic acid when combined with the same substance, as does the sulphuric acid, where its union with lime forms gypsum. But be this as it may, I trust it will hereafter clearly appear, that each of these combinations when fully formed, has receded or departed so very far from the original nutritive matters that compose a considerable proportion of animals and plants, (and which alone can furnish nutriment for other plants and animals,) that but little, if any, nutritious matter can be contained in them. Now, if these very simple and obvious facts had been sufficiently considered, a proper line of distinction would have been long since drawn between the manures that enrich the soil, and those which, by exciting the animal and vegetable matter contained in it to a hasty and unnatural decomposition, exhaust the land.

Oysters abound in many of our rivers and creeks; and large fields near to them have been covered very deeply with the shells of this fish, by the Indians who formerly inhabited those parts. Time, with the decay of animal and vegetable matters, and perhaps of some parts of the shells, had intermixed a small portion of dark looking soil with them. Many of the shells were broken into pieces, but not generally very small; and many seemed to retain nearly their original size; so much so, that, after being riddled, they were burnt, and made excellent lime. These lands (so far as my observation extended,) were far less exhausted by perpetual

* It would seem that finely powdered fresh oyster shells would be very valuable manure, and that much of it might be readily manufactured in our large sea-port towns.

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ploughing and cropping, than other grounds which appeared to have been originally of the same description, but not covered with shells.* No question but they will continue to be fertile, until after the animal matter contained in the shells, and also the enriching matters in the little soil intermixed with them, have been too much exhausted to produce this effect. After this, they will, like "Lincoln Heath, become very unproductive;" for neither the phosphate nor the carbonate of lime, will find sufficient enriching matter to act upon.

The earthy texture of some soils, causes them to be more favourable to the growth of some plants than others; still, practice and observation, without the aid of chemistry, determine that every soil, be its earthy texture what it may, furnishes all the ingredients necessary to perfect any of the plants grown by us, provided a sufficiency of animal and vegetable matter be found in it; unless the grounds be too wet, or other causes equally unfriendly to the growth of the plants, which are esteemed most valuable by us, obtain. We are, however, highly indebted to chemistry, as this science has better explained the ways and means by which these ingredients are introduced, than could be done by practice and observation alone. Of the means by which a sufficiency of lime is introduced, we are told by Dr. Darwin, that "Fourcroy believes, that the ashes of burnt vegetables which have been supposed to consist of earth or clay, when the fixed alkali is washed from them, are principally calcareous phosphorus, like those of animal bones; the same is asserted by Lord Dundonald, in his Connection of Agricultural Chemistry, p. 25, who calls the insoluble parts of vegetable ashes, a phosphate of lime."† Sir H. Davy tells us, "Phosphate of lime is a combination of phosphoric acid and lime, one proportion of each. It is a compound insoluble in pure water, but soluble in water containing *any acid matter*. It forms the greatest part of calcined bones; it exists in most excrementitious substances, and is found both in the straw and grain of wheat, barley, oats, and rye, and likewise in beans, peas, and tares. It exists in some places in these islands, native, but only in very small quantities. Phosphate of lime is generally conveyed to the land, in the composition of other manure."‡ He also says, "calcareous earth is found in the ashes of most plants."§ Likewise, that "the earths found in plants are four: silica, pure clay, lime, and magnesia. They are procured by incineration. The lime is usually combined with the carbonic acid. This substance and silica are more common in the vegetable kingdom than magnesia, and magnesia more common than clay."‖

* More than twenty years have elapsed since I had an opportunity of examining those soils; at that time they were subjected to a system of perpetual ploughing and cropping.

† See his Philosophy, page 213.

‡ See his Lec. on Agr. Chem. page 336. § Idem, page 317.

‖ Idem, page 113.

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Consequently, the fermentation and decay of these plants, together with that of the animalcula, and the dung made by them, and the larger animals who subsisted on the vegetation grown on the grounds, furnish as much lime as is necessarily used in the structure of succeeding plants and animals. Especially as the annual renovation of the shells of some animals seems to determine, that the vessels of animals have the power of increasing by secretion the quantity of calcareous matter, when existing circumstances require this to be done. That plants have the same power, also seems evident, as some of them store up in their cells, vessels and fruit, nutritious food for man and other animals, while others gather a fatal and deadly poison; although they may grow so near to each other, that it is evident each had free access to the same, and, (seemingly,) no other matters, than those from which these very different products were elaborated.

Still the proper application of lime by the cultivator is, in many cases, no less useful: it will excite a thin soil to a hasty and unnatural fertility. This will enable him the more speedily to enrich it by that part of the greatly increased vegetation, which he may readily spare, and very profitably apply to this invaluable purpose.

But as no substances, except those parts of animals and vegetables, that may be decomposed by the natural processes of fermentation and putrefaction, furnish any nutriment for plants, lime in its caustic state ought to be very cautiously used. As should also, every other powerfully corrosive substance, especially fire.

It must be highly injurious to the interests of agriculture, either hastily to consume, or more slowly to corrode, or in any other way, expose those nutritive matters to useless waste.

The economy of nature *in* her management of lime, where calcareous matter greatly abounds, ought to teach us the moderate application of this substance, after it has been rendered caustic by calcination. If the acids formed in some plants, together with the acids formed by the decomposition of all the fresh animal and vegetable matter, existing in or upon the soil, were to accumulate in quantity, and also in strength, sufficient speedily to decompose the carbonate of lime in large quantities, the effects produced by so much corrosive matter might prove very injurious to vegetation It has, however, been wisely ordered that the portion of this powerful matter brought into active use, through the medium of the acids, or by other means, should be so circumscribed, that vegetation is not injured by it. Perhaps this simple, but wise and truly interesting management of nature, may also hereafter teach us, that it would be better, at least in many cases, to use the carbonate, instead of calcined lime, and depend, as she does, on the acids formed in the soil, to decompose the carbonate of lime in sufficient or proper quantities, to excite and promote vegetation: especially, as after the surface of the limestone has been considerably increased by pulverization, it may act as effectually as does marl, after its parts have been minutely divided

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by exposure to the atmosphere; also, prove quite as lasting, provided the quantity of pure calcareous matter in either case be equal.

It will also be recollected, that what happens when sheep are washed in water impregnated with the carbonate of lime, proves that this substance decomposes oily matters. Now as its action on these matters found in the soil, will be much less powerfully corrosive, than that of lime rendered very caustic by calcination, less injury, and much more good, is to be expected from the milder action of the carbonate of lime.

It should also be remembered, that when plants are decomposed, they afford "gum or mucilage, albumen, gluten, wax, resin, and many other substances."* It seems quite as probable that the carbonate of lime will act on some of them as effectually, as actual practice has proved it to act, on the oily matters, composing a part of the compound, forming the yolk of the wool on the body of a sheep. In fact, so little is known of the action of the carbonate of lime, on the various substances found in the soil, and so many absurd and contradictory theories, have appeared on this subject, that but little information is to be gathered respecting it; except from the rational conclusions that may be fairly drawn from such plain, simple, and well substantiated facts, as accident, practice, and observation have made manifest. This being the case, it may be useful to remark, that if the water passing through calcareous countries, had the power to dissolve and convey the carbonate of lime, in much larger quantities than is now generally conveyed by it, neither man, nor the inferior animals, could exist in those parts.

The use of the water from our limestone springs, even in its present state, frequently produces injurious effects; especially until after the constitution has become habituated to the use of it.

This apparent care for the preservation of animals in calcareous countries, seems to strengthen the opinion, that nature had been careful to make equal provision for the well-being of plants, growing on soils of this description, by ordering that the carbonate of lime, should not be decomposed in quantities sufficient to injure vegetation, even where this substance most plentifully prevailed.

It has not only been wisely ordered that putrescent animal and vegetable matter, should afford the proper nutriment for plants, but also that even those parts of animals and vegetables, which afford no nutritious matter, but were found necessary to form and consolidate the structures of animals and plants, should, the most part of them, be employed in exciting vegetation, and also assisting in preparing the nutritive matters, on which plants live.

The alkalies, phosphate and carbonate of lime, appear to be the most extensively employed by nature, in this way, as the structures of plants seem to furnish larger quantities of these, than many

* See Sir H. Davy's Lec. on Agr. Chem. page 73.

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other substances, which are likewise employed by her, in the same way.*

Dr. Darwin and others, appear to believe that all the calcareous matter existing in the world, is of animal origin. It seems evident from the shells which are found mixed throughout large bodies of it, that much lime must have accumulated in this way. Still, lime, as well as some other substances found in plants and animals, may have no more claim to animal origin, in the full sense of those words, than has the silica or alumina, that is, the pure sand or clay found in them, or even the water that forms a considerable part of the bodies of plants and animals.

But in whatever way, calcareous matter may have been first made to exist in the world, it would appear that we are principally indebted to sub-marine animals for the large bodies of lime, known to be of animal origin.†

If this matter had accumulated from the death and decay of the animals and plants that had been calculated to live on the earth, in much greater quantities than nature regularly employed for the use of succeeding generations of animals and plants, it is reasonable to believe that all soils would have long since become, what is generally termed calcareous. Whereas we see extensive tracts of country, that are at this time otherwise, and seem likely to remain so, as long as nature is permitted to pursue her present course in the management of them.

* See several of these substances enumerated by Sir H. Davy in his Lec. on Agr. Chem. page 114.

† It would however appear that this is only to be known by the shells mixed with it.

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CHAPTER II.

The theory of the alkalies, and various saline substances, considered; also, that of gypsum, as established by long and very extensive practical observation.

Sir H. Davy tells us, "The chemistry of the manures which act in small quantities, such as gypsum, alkalies, and various saline substances, has, hitherto, been exceedingly obscure. It has been generally supposed these materials act in vegetation in the same manner as condiments or stimulants in animal economy, and that they render the common food more nutritive. However, it seems a much more probable idea, that they are actually a part of the true food of plants, and that they supply a kind of matter to the vegetable fibre which is analogous to the bony matter in animal structure."*

The bony matter in animal structure partakes largely of lime, and yet that substance is not considered a part of the true food of animals. As lime, however, seems to exist in all animated nature, the food of animals may supply a sufficiency of that substance to answer every purpose designed by nature. Thus, the hen, when running at large, where, on superficial examination, no calcareous matter is found, daily supplies as much of it as is used in the formation of the shell of her egg. The structure of some shellfish, snails, &c. seems to require much more lime in proportion to their size than many other animals; still it appears that nature has so organized them, that a sufficiency of this matter is evolved to form their structures in every situation in which they exist. This gentleman elsewhere observes, that "the general tendency of the alkalies is to give solubility to vegetable matters; and in this way they may render carbonaceous and other substances capable of being taken up by the tubes in the radical fibres of plants." Likewise, that "the same reasoning will apply to the operation of the pure mineral alkali as to the vegetable alkali;" and that "salt in small quantities assists the decomposition of animal and vegetable matter."†

Now, if this very correct reasoning be admitted, I cannot see why they may not still be considered stimulating manures, or why he should assert, that "the chemistry of those manures had hitherto been *exceedingly obscure*," when, on the contrary, it clearly appears that his theory involves the subject in far greater obscurity than that in which he found it. However, as it by far too often hap-

* See his Lec. on Agr. Chem. pages 18 and 19.
† Idem, pages 337 and 338.

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pens, this gentleman in another part of his book, and when, as I suppose, he had forgotten what he had just before asserted, says, "The theory of the operation of alkaline substances, is one of the parts of the chemistry of agriculture *most simple and distinct.* They are found in all plants, and therefore may be regarded as among their essential ingredients. From their powers of combination likewise, they may be useful in introducing various principles into the sap of vegetables which may be subservient to their nourishment."*

It is very justly observed by Sir H. Davy, that "the doctrine of definite combinations will assist us in gaining just views respecting the composition of plants and the economy of the vegetable kingdom; but the same accuracy of weight and measure, the same statistical results which depend upon the uniformity of the laws that govern dead matter, cannot be expected in the operations where the powers of life are concerned, and where a diversity of organs and functions exists. The classes of definite inorganic bodies, even if we include all the crystalline arrangements of the mineral kingdom, are few compared with the forms and substances belonging to *animated nature.* Life gives a peculiar character to all its productions: the power of attraction and repulsion, combination and decomposition, are subservient to it. A few elements, by the diversity of their arrangement, are made to form the most different substances; and similar substances are produced from compounds, which, when superficially examined, appear entirely different."† But, notwithstanding these very correct sentiments, he seems to estimate the usefulness of gypsum as a manure, by the quantity which he finds of it in plants.

He observes, that "those plants which seem most benefited by its application, are plants which always afford it on analysis. Clover, and most of the artificial grasses, contain it; but it exists in very minute quantity only in barley, wheat, and turnips."‡ He, however, says, in another place, "it is *not* taken up in corn crops, or crops of peas and beans; but where lands are exclusively devoted to pasturage and hay, it will be continually consumed."§ Here again, this gentleman seems to contradict himself; for, agreeably to his theory, it would be difficult to determine how gypsum exists even in very minute quantities only in barley and wheat, if it is not taken up in corn crops, for barley and wheat are called corn crops by every farmer in England.

But if gypsum is to be considered a part of the true food of plants, because it is found in them, and more especially so, for those plants in which it may happen most plentifully to exist, why may not siliceous earth be also considered a part of the true food of plants, especially for the reeds, grasses, canes, wheat, and other plants having hollow stems, as Sir H. found much of this substance

* See his Lec. on Agr. Chem. p. 20.
† Idem, p. 53 and 54.
‡ Idem, p. 19.
§ Idem, p. 333.

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in the cuticle or epidermis which covers the bark of plants of this description? But in place of considering the siliceous earths a part of the true food of those plants, he very wisely observes, "The siliceous epidermis serves as a support, protects the bark from the action of insects, and seems to perform a part in the economy of these feeble vegetable tribes, similar to that performed in the animal kingdom by the shell of the crustaceous insects."*

It is well known in this country, where gypsum has been long extensively and very successfully used, that it is a valuable manure for both barley and wheat, and likewise for peas and beans. Notwithstanding this gentleman says, that, "in general, cultivated soils contain a sufficiency of this substance for the use of the grasses,"† it is as well known in Pennsylvania as any other fact, that but very few soils of this description contain a sufficiency of gypsum to produce even tolerable crops of the grasses; and that when this substance is strewed over even very thin soils, they are excited to produce luxuriant crops of red clover. It is also equally as well known, that the fermentation and decomposition which take place in soils that have been highly enriched with animal and vegetable matter, either by nature or art, furnish a sufficiency of nutriment for the grasses, as well as other plants, without being manured with gypsum; of consequence, but little, if any perceptible good is generally derived by manuring such soils with that substance. Where enough of vegetable and animal matter exists to excite a sufficient decomposition of nutritious matters, it is not only useless but also very wasteful to increase the fermentation and decomposition of these invaluable substances, by the use of stimulating manures of any kind.

Agreeably to Sir H. Davy's estimate, "gypsum is composed of 55 parts of lime and 75 parts of sulphuric acid," and "is soluble in about 500 times its weight of cold water, and is more soluble in hot water."‡ If the soil and atmosphere be dry when gypsum is strewed it remains inert, but so soon as they become sufficiently moist and warm, it gradually dissolves, and its powerful effect on vegetation is soon seen. It is generally believed, sulphuric acid in this compound is the principal promoter of vegetation, as sulphur alone,§ and also the substances in which it is found, seem to produce similar effects on vegetation. It should however be remarked, that in the case where it was supposed that sulphur alone was used as manure, ashes were mixed with it to render the sowing easy, and ashes are in themselves a powerfully stimulating manure. A black sulphuric substance, which abounds in New Jersey, has proved to be a very valuable manure. It was analyzed by Dr. Seybert, and found to be a ferruginous clay.‖ Sir H. Davy says, that "some inte-

* See his Lec. on Agr. Chem. pages 56 and 57.
† Idem, page 19. ‡ Idem, page 329.
§ See vol. ii. Mem. Phil. Agr. Soc. page 207.
‖ See vol. i. Mem. Phil. Agr. Soc. pages 93 and 94.

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resting documents on the use of sulphate of iron, or green vitriol, which is a salt produced from peat in Bedfordshire, have been laid before the board by Dr. Pearson; and I have witnessed the fertilizing effects of a ferruginous water used for irrigating a grass meadow made by the Duke of Manchester; an account of the produce of which, has been published by the board of agriculture. I have no doubt but the peat salt and vitriolic water acted chiefly by producing gypsum." He also says, "vitriolic impregnations in soils where there is no calcareous matter, as in a soil in Lincolnshire, to which I referred in the fourth lecture, are injurious; but it is probably in consequence of their supplying an excess of ferruginous matter to the sap."*

This is saying no more than is said of lime, or any other corrosive substance, when too great a quantity is used, and no question but ferruginous matter will be equally fertilizing, where, on superficial examination, no calcareous matter is found, provided an excess of it be not applied; although much greater quantities of it will not injure vegetation in calcareous soils, or even in grounds of a contrary description, if a sufficiency of lime be used.

The sulphate of barytes,† as well as the pyrites,‡ are also very valuable manures; and as sulphurets are powerful solvents of carbonaceous substances, it would seem that gypsum assists the decomposition of the animal and vegetable substances found in the soil.

The powerfully fertilizing property of the sulphuric acid appears to be well established; still it seems reasonable to believe, that it is its combination with lime, that causes the surprising effects which are produced by gypsum. Effects equally as astonishing have been produced by other combinations;§ and they only cease to be equally wonderful to the chemist and man of science, in whose laboratories the causes which produce the effects are more readily seen, than in the great laboratory of nature, where it is probable, that hidden and combining causes will forever, more or less, defeat the experiments of the wisest chemists under the sun: especially when these experiments are not confined to subjects, which have been rendered familiar by long practical observation.

Sir H. Davy says, "It has been said, that gypsum assists the putrefaction of animal substances, and the decomposition of manure, I have tried some experiments on this subject which are contradictory to the notion. I mixed some minced veal, with about one hundredth part of its weight of gypsum, and exposed some veal without gypsum under the same circumstances; there was no difference in the time when they began to putrefy, and the process

* See his Lec. on Agr. Chem. pages 334 and 335.
† See vol. iii. Mem Phil. Agr. Soc. page 120.
‡ See vol. i same work, page 33, appendix.
§ The effects produced by the compound which forms gunpowder are equally surprising.

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seemed to be most rapid in the case in which there was no gypsum present. I made other similar mixtures, employing in some cases smaller quantities of gypsum; and I used pigeon's dung, in one instance, instead of flesh, and with precisely similar results. It certainly in no case increased the rapidity of putrefaction. Though it is not generally known, yet a series of experiments has been carried on, for a great length of time in this country, upon the operation of gypsum as a manure."*

These experiments seem to have been predicated on what is said by Judge Peters, of the decomposition effected in dung heaps, by the use of gypsum. I do not recollect, that any other person has written on using plaster in this way.

Gypsum may favour the decomposition of animal and vegetable matters, when mixed and heaped up with them; but neither Mr. Peters's compost heaps, nor Sir Humphrey's smaller experiments were calculated to determine the action of gypsum when it is spread over or mixed with the soil, or when seeds are rolled in this substance, previously to their being sown.

It is clearly seen in the experiments introduced by the president, with a view to refute what Sir Humphrey had advanced on the action of gypsum, that no certain information can be gathered from them.

Judge Peters says, "Two years ago, I scoured the ditches of a watered meadow; I had a great collection of tussocks, composed of aquatic, coarse grasses, and weeds. I composited those materials, in two heaps; one contained sixty-two two horse cart-loads after it was rolled down, the other twelve of like loads. In the first I began with a layer of tussocks; then a layer of muck from the stables, in a fermenting state; next a layer of leaves and wood soil, (each layer about one foot thick,) until the heap was sufficiently high. On each layer, I strewed plaster very little thicker than I should have scattered it on the ground. This was done in autumn. In the spring I began to throw it over, and mixed with it a quantity of slaked lime. I found the heap far advanced in putrefaction; so that after being thrown over, it was, in the fall, in the best order for top dressing. There was in this heap, not above four bushels of plaster used. In the small heap, I employed no muck or dung; but formed it of alternate layers of tussocks and leaves, intermixed with wood soil. Each layer was plastered, but the labourer strewed nearly the like quantity, in the small heap with that mixed in the large one. When I came to view it in the spring, very little progress had been made in putrefaction. I was compelled to throw it over twice, during the summer. I found it in the fall, unfit for use. The plaster was unchanged in many parts of the heap: so was a considerable proportion of the leaves and tussocks. I suffered it to remain until the last spring; when I found it imperfectly rotted, and much of the plaster unaltered. None of the

* See his Lec. on Agr. Chem. pages 331 and 332.

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plaster in the other heap was visible; but the spot on which the small heap was spread, was universally whitened with it."

"Having frequently and successfully rotted down leaves, tussocks and wood soil, plastered lightly, I was surprised at the disappointment in this instance. I cannot account for the circumstance, otherwise than by presuming that an overcharge of plaster is a quiescent force; that is, it preserves compounds in a state of rest. A moderate quantity may be devellent; that is, it assists in destroying a state of combination; plaster must no doubt, be decomposed itself, before it acts on other substances. So must be marine salt, which is also a chemical compound. The instance I relate, reminds me of the fact, and my conclusions from it, mentioned in our first volume, p. 174. No more of the plaster will act, than the materials, necessary to co-operate with it, require. The balance remains in its original state of composition, inert and useless."*

Here this gentleman seems to advance opposing theories: first he says, "An overplus of plaster preserves compounds in a state of rest; a moderate quantity assists in destroying a state of combination." Secondly, "No more plaster will act, than the materials necessary to co-operate with it, require; the rest remains in its original state of composition, inert and useless."

It is the "whimsical" and unfounded observations made on the action of gypsum, that have caused this substance to be considered "whimsical" in its operation. So far as my observation extends, it is no more "whimsical" than other stimulating manures. If the seasons be so dry or wet as greatly to retard fermentation, or if the soil be naturally so wet as to cause the same effect, crops commonly suffer. They, however, suffer vastly less, where animal and vegetable matters obtain in quantities sufficient to furnish, even under all the disadvantages arising from either, a considerable supply of decomposed matters for the food of plants. It should be recollected that where animal and vegetable matter in an abundance obtains, evaporation is greatly retarded in a dry time; also, that water sinks more readily through the texture even of retentive clay soils, when the earthy matter is considerably divided by decaying vegetable substances; likewise, that fermentation is greatly promoted by the increased quantity of animal and vegetable matters thickly spread through a rich soil.

In fact, plants growing on rich soils, far better resist all the various injuries to which vegetation is subjected, than those growing on soils of a contrary description; for although it has been asserted by too many, that better crops of red clover have been excited by gypsum on poor soils, than by dung on soils of the same description, I have invariably witnessed the reverse. Neither can this generally happen, if enough of dung be applied to make the soil rich, and the application of it so ordered, that fermentation and decomposition will diffuse

* See vol. iii. Mem. Phil. Agr. Soc. pages 297, 298 and 299.

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the rich nutritive matters contained in it through the soil in proper time, and in sufficient quantities to afford an abundance of food for the plants growing on it.*

But to return; if Mr. Peters, had depended on the gypsum to effect the decomposition which he wished, why did he also apply the slaked lime. And after obtaining all the assistance that is to be derived from this powerfully corrosive substance, and also, from the exciting properties of the dung taken from his stables in a fermenting state, why does he introduce this experiment to substantiate the decomposition effected by gypsum when used in this way? When, in fact, nothing is to be gathered from either of his experiments, except that gypsum, aided by nature alone, is incapable of perfectly decomposing, in the course of eighteen months, a compost heap, formed of the materials described by him; also, that it cannot be certainly known, from what happened in either of the heaps, whether gypsum does, or does not, favour the decomposition of animal and vegetable matters, when mixed and heaped up in bulk with them; particularly, as it would seem, that without the powerful assistance of the lime, the exciting influence of the dung alone, would have been sufficient to accomplish the decomposition of the larger heap in twelve months; and that nature, without the aid of gypsum, might have decomposed the smaller one, as far as Mr. Peters represents it to have been done in the time mentioned by him, unless indeed, "an overcharge of plaster preserves compounds in a state of rest," which seems to be as contrary to practical observation as it is to what this gentleman also advances, to wit: "no more of the plaster will act, than the materials necessary to co-operate with it, require." But whether he is correct in saying, "the balance remains" (undissolved, and otherwise exactly) "in its original state," no practice or observation of mine will determine.

However, before Sir H. Davy had attempted to controvert the theory of the action of gypsum when used for manure, he should have recollected that this theory had been founded on long, as well as very extensive, and successful practical observation; and that his practical information must have been very limited, as this substance had been used with but very partial success in England: owing either to local and unknown causes, or to an improper system of management; also, that the limited compass in which the usual practice of chemistry places experiments, is by no means calculated to determine the action of gypsum when used as manure.

He tells us the veal, without gypsum, was exposed under the same circumstances, as was that, which had been mixed with this substance; but he does not say how either was exposed. It is

* Stimulating manures have produced wonderful effects, especially when the seasons have favoured the operation of them. It should, however, be recollected, that enough of enriching matter does not exist in a poor soil to enable even gypsum to produce effects, any thing like equal to those produced by a sufficiency of enriching substances.

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however probable, in his yard or garden, on plates, or some other utensils, calculated to keep the materials, so that they might be readily examined. In any case, that was likely to happen, the exposure must have been very dissimilar to that which takes place in actual practice. The materials used by him, were necessarily confined within a very contracted space, when compared with the wide scattered scope, in which practice places this substance, in contact with the materials brought into action by it: consequently, the numerous substances that are known to exist, or to be floating in the atmosphere, as well as the unknown cause that may exist there, could not have had any thing like the same free access to the materials composing his experiment, as is obtained by actual practice; and for aught we know to the contrary, some of these substances may, either separately or combined, act on, or in union, with the gypsum, so powerfully, as greatly to promote the action of it.

There are also upon and within the soil, a great variety of substances known to us, and perhaps many others, with which we are not acquainted. None of these had access to Sir Humphrey's experiment; although we do not know, but it may be utterly impossible for gypsum to act profitably, in any other way, than in conjunction with some or more of them.

The earth, except when the atmosphere is more fully charged with water than it, is continually emitting great quantities of moisture, even in a dry time. No question but it conveys, in combination with it, more or less of the properties of the various substances contained in the soil through which the moisture passes. This highly interesting part of the economy of nature seems to secure a double action of moisture; especially where the soil is shaded closely by the plants growing on it. First in the ascent of the exhalations from the ground. Secondly in the descent of this moisture in showers, dews, fogs, &c. The first of these operations of moisture seems to be excluded from Sir Humphrey's experiments. As it appears to be progressing, when some of the other sources of moisture are suspended, it may be very important to the action of gypsum: especially if this substance is not dissolved in less than "500 times its weight of water, unless the water be hot."*

This gentleman should also have recollected, that when gypsum is strewed over the soil, or mixed with it, it is brought into immediate contact with animal and vegetable substances, which are generally in a progressive state of fermentation and decomposition; also,

* Burnt limestone is very quickly slaked, if a sufficiency of water be poured on it. The same however is as effectually, but much more gradually done by the moisture gathered from the atmosphere. May we not therefore presume that gypsum is as effectually, (but more gradually) dissolved by the rains, dews, &c. as it would be, if immediately immersed in the whole quantity of water, necessary to dissolve it; especially if it be very finely ground, or pulverised, as this greatly increases the surface, on which the moisture acts.

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that these matters contain a great variety of substances, which nature had already been preparing either to nourish, or excite vegetation in every possible way that existing circumstances would permit: consequently the plaster when strewed over, or mixed with the soil, commences its operations under very favourable circumstances, and most probably, in union with some very powerful auxiliaries.

Veal is a substance that naturally becomes putrid with by far too great rapidity, to admit of forming any just conclusions of the action of gypsum on it. It is doubtful whether the pigeon's dung favoured Sir Humphrey's experiments more than did the veal, it "readily ferments,"* and being a very rich substance, sinks quickly into decay. This gentleman says, that, "after night soil, pigeon's dung comes next as to fertilizing power;" also, that, "it is evident that this manure should be applied as new as possible."†

In fact, unless chance should happen to direct, it will be found that the action of gypsum is a difficult question to be determined by the usual round of chemical experiment. It would seem that Sir Humphrey might have known this full well, from his not being able to obtain from the series of experiments, which he says has been carried on for a great length of time in England, any information on this subject, which he considered more important than the experiments related above.

It would appear that rich substances which naturally hasten into decay, are the worst that could be selected to determine in any way, the action of gypsum. But be this as it may, certain it is, I have never observed, that the application of this substance occasioned any perceptible difference, either in the colour, size, or product of any plant, growing on any soil, in which there was a sufficiency of animal and vegetable matter, to produce good crops of it. The reason seems obvious; the natural fermentation of animal and vegetable matters, where enough of them obtains, supplies sufficient nutriment to effect this purpose; and an excess of nutritious matter, saying the most that can be said in favour of it, is useless. Of consequence, it is only in soils where animal and vegetable matters are scattered so thinly, as to retard fermentation and decomposition, that the wonder-working powers of gypsum are seen. Therefore it is on such soils, that I would advise Sir Humphrey Davy, (or any other gentleman who wishes to become well acquainted with the action of gypsum,) to try their experiments, more especially on soils, that have been considerably exhausted by perpetual ploughing and cropping. On grounds of this description, the action of gypsum, may be as readily determined through the medium of practical observation, as that of any other manure. If only the half of one bushel of this wonder-working compound, be

* See his Lectures on Agr. Chem. page 299.
† Idem, same page.

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finely pulverised, and evenly strewed over an acre of red clover, growing on a soil which is too poor to produce even a tolerable growth of this plant, the crop is generally good and sometimes luxuriant. No fact is better established than this. It has been the common practice in Pennsylvania with farmers, to leave strips through their clover fields, on which none of this substance is strewed. In every case, so far as my observation has extended, (when the soil was too thin to produce even tolerable crops of red clover without the aid of manure,) the plants on the strips where no gypsum had been strewed, were small, sallow, and apparently starved, while those growing beside them, on the grounds manured with this substance, were large, healthy, and vividly green.

It is also a well known fact, that if those thin soils be annually stimulated by the regular application of gypsum, and the product be removed, they soon become so much exhausted as to be incapable of producing crops, that are worth mowing.

It is equally known, that after this sterility takes place, gypsum strewed over the soil, (in any quantities, either large or small,) produces no more perceptible effect on vegetation, than would do the same quantity of sand, or any other earth.

But if after this sterility takes place, enriching manure be applied, the future applications of gypsum will act again in the same powerful manner, as they did in the beginning; even if the manuring be nothing more than the contents of such a green crop, as the fermentation and decomposition of the vegetation found on the soil will produce.

Now if gypsum furnishes food for plants, how does it happen, that no quantity of this substance, either great or small, is found capable of promoting even tolerable fertility, after the animal and vegetable matters contained in the soil, have been exhausted by this powerful promoter of vegetation?

And how does it happen, that after this sterility has been effected, that plaster acts as powerfully as it did in the beginning, so soon as enriching manure has been applied?

I would also ask, whether it is even probable that simple calcareous earth, and the sulphuric acid which had been locked up for ages in it, can, either separately or combined, furnish any nutritive matter for the food of plants? Likewise, if nutritive matter exists in this compound, whether it would not be exceedingly difficult to believe, that the quantity contained in only half a bushel of gypsum could do any perceptible good to so many clover plants, as are commonly grown on an acre of ground?

It would, however, seem that Judge Peters's practice in the use of this substance, on soils that were trench-ploughed, furnishes sufficient proof to determine that gypsum cannot act, unless it finds sufficient animal and vegetable matter in the soil to act upon.

Some years ago this gentleman trench-ploughed a good deal of thin soil; and if I understand what he has written on that subject,

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this was done with a view to make it better; but as he seems to have abandoned the practice, it appears probable that the result has not been such as he had expected it to be. Be this, however, as it may, he discovered, in the course of this practice, that "plaster does not operate till animal or vegetable putrefied substances are restored to trenched soils." Also, that "the corn planted on them requires shovelings or dung in the hills, to give activity to the plaster."*

* See vol. i. Mem. Phil. Agr. Soc. page 243.

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CHAPTER III.

Gypsum, the alkalies and various saline substances, together with other matters found in the structure of plants, are highly important in the economy of vegetation. Still, stimulating manures should be cautiously and prudently used; especially as every soil is fertile, if a sufficiency of animal and vegetable matters exists in it. The economy of nature in the management of our forests, glades and prairies described. The quantity of animal matter considerably increased by the introduction of innumerable animalcula. Also, the extensive usefulness of the plants which are considered useless and injurious by too many farmers, and the provision made by nature to spread them over exhausted soils, &c. and to accumulate animal matter by the introduction of them.

It is said by Sir Humphrey Davy, that "water and the decomposing animal and vegetable matter existing in the soil, constitute the true nourishment of plants."* But as he also says, "It seems probable that the manures which act in small quantities, such as gypsum, alkalies, and various saline substances, are actually a part of the true food of plants," it is considered proper to observe, that although neither gypsum, the alkalies, nor various saline substances form any part of "the true nourishment of plants," those and other substances are highly important, as they form a part of the structure of plants and animals: consequently, the decomposing animal and vegetable matter existing in the soil, furnishes these substances. In this state they again become highly important to vegetation, not only in forming the structure of succeeding generations of plants, for the greater part of these substances also assist in exciting vegetation, and in preparing the nutritious matters on which plants live. In fact, it would seem that these substances are the natural condiments, in the animal, as well as in the vegetable economy. Man, as well as the inferior animals, is quite as healthy and vigorous, and perhaps more so, where he does not obtain any other stimulants than those contained in the food used by him.

The quantity of the different substances found in vegetation, depends greatly on the nature and properties of the plants; also, on the property of the soil, and other local causes existing where the plants grow. Still, all soils that have been sufficiently enriched with animal and vegetable matter, either by nature or art, furnish enough of nutriment, as well as the necessary ingredients to form the structure of plants, and excite vegetation, &c. so that luxuriant crops are grown on them.

* See his Lec. on Agr. Chem. page 184.

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Now this fact is evident, and the practice of ages determines, that land is impoverished in proportion as the animal and vegetable matter contained in the soil is destroyed, by severe cropping, or in any other way; and that although gypsum, lime, and other stimulating manures, will, for a time, increase the fertility of such impoverished soils, yet the continued application of these substances is so far from enriching the soil, that it hastens the sterility of it, unless the evil be prevented by a timely introduction of animal and vegetable matter. It certainly then behoves the farmer to use the stimulating manures cautiously and prudently, and to take every rational measure to accumulate animal and vegetable matter; also, to be careful not to engage in any of those practices, that devote these substances either to immediate destruction, or to a more gradual but useless waste.

If the manures which are generally called stimulating, "actually afford a part of the true food of plants," this part must be very inconsiderable, as no given quantity of these manures, either separately or combined, will preserve the fertility of any soil.

Long practice in our gardens also demonstrates, that a moderate and regular application of animal and vegetable manure, will not only keep up, but likewise increase the fertility of the soil, when subjected to very severe annual cropping.

Our towns and villages have been built where chance directs, or convenience dictates; still the gardens, so far as my observation extends, produce luxuriantly; although no other means are generally used, either to correct offending matter, or enrich the soil, but stable manure, unless it be to drain the grounds if they happen to be too wet. The same result has also followed the application of the same kind of manure, in every field where I have known it applied in quantity sufficient to produce the same effect.

But the value of animal and vegetable matter is best seen in our lonely forests, where neither art nor ignorance has materially interfered, with the simple but wise economy of nature. Every where that vegetation can exist, the ground is covered with it. The largest trees the soil and climate are capable of producing, first claim our attention. These seem to be placed at proper, though not at regular distances apart. If two or more of them happen to grow up in contact, or nearly so, more room is allotted for their growth. The space between the larger trees is occupied by some smaller ones, shrubs, and annual plants. The whole gradually descending in size, from the largest trees to the mosses. So careful is nature to spread vegetation, wherever it can be done, that we often see a variety of plants growing on the trunks of the fallen timber, after the sap-wood has become sufficiently decayed to admit vegetation. As these trunks sink into decay, the plants sink with them, and take root in the earth.

When the fallen timber on which the plants grow, happens to be of very durable wood, we sometimes see large trees standing upon

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the trunks of large fallen timber. Their roots having passed down on each side of the trunk, through the rotten sap-wood, find their way into the soil, and become firmly established in it. The fallen leaves of each year form a compact covering over the leaves, and much of the other vegetation that had fallen before. This prevents the growth of such grasses as would injure nature's design, as they do in our orchards. This covering is skreened during winter by the stems and branches of the plants. In the summer, when the sun and the winds would prove more injurious to the manure under it, an additional and much more effectual skreen is formed by the foliage of the plants. The fermentation and decomposition that take place within this thick body of manure, furnish nutriment for the plants, and enrich the grounds; and also minutely divide and keep the soil more open and mellow for the ready admission of their roots, than could be effected by the general mode of cultivation pursued in fields. Here I wish the reader to recollect, and attentively consider, that this is done without rending and wounding the roots of the plants, or forming injurious ridges or mounds beside or around them, or making furrows to run off the moisture necessary to their growth.

When age, disease, tornadoes, or any other cause destroys the timber, and nature is suffered to repair the damage, another growth of plants quickly appears. These are so thickly set on the ground, that all vegetation injurious to them is destroyed by their shade. The most thrifty plants outtop and gradually destroy, by their shade, and the nutriment drawn from the soil, the more feeble ones. The shade formed by the upper branches of the surviving trees, destroys the supernumerary branches beneath them, until nature has gradually pruned the trunks of the timber so effectually, that an injurious limb does not appear to a very great height. Their lofty tops overspread the tops of the smaller trees, shrubs, and other plants, which nature had calculated to grow, and flourish luxuriantly under the shade of their lofty superiors.

The regular fall of the foliage, together with that of the branches, and the bodies of the trees and other plants, affords a prodigious mass of decaying vegetation. The larger animals, reptiles, &c. common to the country, together with the feathered tribes find sufficient food and shelter here. Every leaf and every crevice in the bark or elsewhere, is thickly peopled. Even the decaying animal and vegetable matter, which is so disgusting to some animals, teems with animalcula calculated to fare sumptuously on it. The interior of the soil also affords living and decaying vegetation, on which innumerable worms and other animalcula live voluptuously. It is also probable that incalculable tribes of animalcula which are so small as to elude our sight, live plentifully on the dead carcasses, and on the scraps and crumbs left by the large ones: added to this, the quantity of animal matter is prodigiously increased, by the creation of animals of every size, whose existence either in part or altogether depends on preying on others. The existence of the smaller animals is generally

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very limited. Those short lived generations multiply fast, succeeding each other in rapid progression. While they live, the remains of their food are returned to the soil in valuable manure. When they die their carcasses add greatly to the amount. We may form some idea of the quantities of this manure, by observing it thickly spread on the bare ground or pavement in yards under the trees. That of the larger insects which inhabit the tree, is readily seen. Although the manure dropped by the smaller ones, may elude superficial observation, it is equally valuable in porportion to the amount. The quantity and quality of the manure furnished by animalcula, like that from other animals, must greatly depend on the quantity of food, and the quality of the substances eaten by them. But nature has so ordered the multiplication of the different kinds of animals, that they seldom seriously infringe on the sustenance of each other. Therefore, generally, all have an abundant supply. She sometimes, however, suffers some one tribe of them to increase in such vast numbers, that the earth seems covered by them, and every green thing which is agreeable to their taste is destroyed. This may be done to convince us that numbers will readily compensate for deficiency of size. Be this, however, as it may, although in general the animal matter derived from any one single tribe of animalcula may be inconsiderable, still the whole combined form a mighty mass of it. When this is added to that supplied by the larger animals, it is fully adequate to all the purposes which nature had designed to be accomplished by it.

It was certainly a very wise provision of nature, to cause the greater part of this matter to exist in small bodies. This has vastly increased the quantity, and promoted the ready and effectual application of it. If the whole or the greater part of this prodigious bulk of animal matter, had been made to exist in the larger animals, they could not have been supported; neither, could the manure furnished by them have been so intimately blended with the soil, as is the vegetable matter, which we all see has been made to exist in plants, that spread over and cover the surface of the habitable parts of the earth.

Animal and vegetable matters afford a very similar food for plants. Yet the former in proportion to quantity, furnish vastly more nutriment for them, and being much sooner decomposed, the fermentation of vegetable substances is greatly accelerated, when animal matter is mixed with them. Therefore, nowithstanding earth, air, light, heat, moisture and vegetable matter are sufficient to perfect vegetation, still the combination of animal with vegetable matter, greatly facilitates the growth of plants. The fertilizing effects of this perfect system of economy, is equally as clearly seen in our glades and prairies, as in our forests, where nature is suffered to pursue her own course.

But when civilized man encroaches on either, a new order of things takes place; the living as well as the dead vegetation found in his way is destroyed and the grounds are cultivated. By these

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means, by far the greater part of the animalcula within, as well as upon the soil are destroyed. Still when the agriculturist keeps the grounds well stored with the grasses, and has a sufficiency of domesticated animals to eat this vegetation, and carefully saves and judiciously applies the manure afforded by them, nature is assisted by art, and the fertility of the soil is considerably increased.

The back-woods farmer, however, too generally continues ploughing, and severe cropping, with but little attention to grass or live stock, and but too seldom returns to the soil, even the little manure that is made by his scanty stock of cattle, until the land is so much exhausted, that scarcely a sufficiency of grass is found on his fields, to support a respectable tribe of grasshoppers alone.

Far less is to be expected from animalcula manure, after the grounds have been cleared from the vegetation grown on them by nature; still much food is provided for them in the grasses, where a proper system of husbandry is practised. They multiply with great rapidity both within and upon grass grounds. When the lay is cultivated they are generally destroyed, and the animal manure introduced by them, is far from being inconsiderable. Yet farmers seldom notice this very useful part of the creation, except with evident marks of abhorrence or detestation, when their persons, crops, or live stock, are annoyed by them. Although it would appear at least probable, that neither man, nor the domesticated animals in which he seems to be more immediately interested, could have existed in any thing like the same numbers, or have been supplied with an abundance of nutriment, if animalcula had not been created. The same may be said of weeds, notwithstanding slovenly farmers complain still more loudly of the injury done by them.

It is true, that very serious injury is sometimes done by animalcula. It is, however, probable, that even this seeming evil is a real advantage. It often excites the farmer to a far better system of management.

Thus the turnip fly urges him to manure his grounds, and to put them in a high state of cultivation, that the plants, by quickly attaining their rough leaves, may escape the destructive depredation of this insect.

To avoid the ruinous injury done by the Hessian fly, farmers were compelled to sow late; but finding that late seeding in a thin soil, subjected the wheat plants to great injury in the winter and early part of the spring; also, that if the main shoots of the plants were destroyed by the fly, but little was to be expected from the later and weaker shoots when the soil was poor, they were obliged to manure their grounds. Now one corner of a field produces more wheat, than was obtained from the whole of it, previously to the depredations committed by this insect.

The plants generally called weeds are very numerous, while those plants which are cultivated by us are few; notwithstanding weeds are injurious to our crops, and we are compelled to wage a

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perpetual war against them, it is probable that some of them would be equally as valuable to us, as our favourite plants, if they were as well known. No question but all of them are either directly or indirectly calculated to promote the interest of man. They are very beneficial where a bad system of farming is pursued. While the ground retains tolerable fertility they grow plentifully, and no doubt but they return to the soil much fertilizing matter, for many of them are strong and vigorous plants. They also furnish food for the animalcula, that had been calculated to live and fatten on them. In this way a portion of animal matter, is likewise returned to the soil. Notwithstanding the too general mode of cultivation is calculated to destroy a great part of the animal and vegetable matter obtained in this way, still enough remains to increase the crops, and to procrastinate that debility, which is so clearly seen in worn out soils, by the growth of the weak and meager grasses and weeds, which are thinly scattered over them. However, where the agriculturist pursues a rational system of husbandry, it becomes necessary for him to extirpate weeds; as the grasses are far better than a promiscuous growth of them. If the former be used for no other purpose, than that of ploughing them under the soil, or suffering them to rot on it; and if they be consumed by domesticated animals, their value is much increased.

But the plants which are called weeds by us, are more especially and extensively useful, where nature acts uncontrolled by man. The immense variety of them, furnishes her with plants calculated to be advantageously grown, in every soil, climate, and situation where vegetation can exist.

Thus the amazing aggregation of peat or moss, where an excess of moisture, or other causes render other vegetation impracticable, affords fuel in abundance; also a valuable manure. When population renders the cultivation of those bogs useful to man, art converts them into very rich and luxuriant fields.

Weeds also furnish nature with plants, that are calculated to grow where scarcely any soil exists. The decomposition of them, and the animalcula supported by them, eventually enrich, and greatly increase the depth of such soils. Thus we see the mosses growing on the hardest rocks, and when a sufficiency of soil is introduced by the decomposition of them, that they are followed by stronger plants; and no question but larger and more nutritive plants, continue to succeed inferior ones regularly, until the soil becomes sufficiently rich and deep to grow luxuriant vegetation.

It is probable that time and combining causes may assist this process, by decomposing the surface of the rocks; but obvious causes alone are sufficient to effect this purpose.

The sense of smelling informs us, that the air may be highly charged with putrid animal and vegetable effluvia. We see that the winds are capable of conveying this, together with light, dry vegetable and animal matters, as well as earth in the same state, to a very considerable distance. Birds and quadrupeds, as well as

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water, effect the same purpose to a greater or less extent. A multitude of seeds are also formed to be conveyed by the same agents to extended, as well as more limited distances. Even the rains convey the substances necessary to an efficient vegetation. Sir H. Davy says, that he "procured from common distilled water, alkalies and earths." Also, "when distilled water is supplied in an unlimited manner to plants, it may furnish to them a number of different substances, which, though in quantities, scarcely perceptible in the water, may accumulate in the plants." Consequently the substances contained in water that has not been distilled, must be much more considerable.

Thus, even the summits of the hardest rocks, standing high above the earth, or far distant in the ocean, may be furnished by the agents mentioned above, with every ingredient necessary to an efficient vegetation.

Here I beg leave to observe, that without the aid of the ingredients which have been enumerated, no efficient vegetation can take place.

Sir Joseph Banks has very ingeniously endeavoured to prove, that the fungus causes the mildew in wheat; and Sir H. Davy has followed in the same track. It seems however difficult to conceive how vegetation can exist on the smooth skin or bark of a healthy plant where no traces, necessary to the growth of it, appear.

Other gentlemen consider this vegetation an effect proceeding from the cause of mildew. The latter opinion appears to be founded on reason, for the rapid decay of that part of the straw affected by mildew, quickly furnishes all the materials necessary to the efficient growth of this vegetation, as the structure of wheat as well as other plants partakes largely of earth. Sir H. says, "the misletoe and ivy, the moss and lichen, inflexing on trees, uniformly injure their vegetative process, though in very different degrees. They are supported from the lateral sap vessels, and deprive the branches above, of a part of their nourishment."* It would, however, appear, that the mosses and misletoe on trees vegetate and grow, where disease and decomposition in the bark prepare the necessary ingredients for an efficient vegetation. The bark is always more or less corroded by insects; and if care be not taken to prevent the injury, a premature decay, without the assistance of this vegetation, often destroys the trees. There is also a roughness in the bark of most trees, especially after it has been sometime formed, that seems to be sufficient to retain the ingredients necessary to an efficient vegetation, and they may be readily conveyed in the way described above. Shaded situations and moist climates seem to favour the growth of this vegetation, for in such situations trees are more especially injured by it. We often see the northerly exposure of the roof of a house covered with the mosses. It is very observable that this vegetation is generally first seen where the shingles lap, grow-

* See his Lec. on Agr. Chem. page 266.

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ing out from where the butt of the uppermost shingle is in contact with the one underneath it. It is here the ingredients necessary to an efficient vegetation first lodge. The rains, except when very light, pass over the butt of the shingle, as does the water over the tumble of a mill dam, and the collected matters together with the seed, remain secure. Every succeeding growth of the mosses, increases the means to retain the matters necessary to vegetation, as does the decay of the plants, until the roof is covered with moss.* If a water-spout, or any other thing calculated to retain these matters to a considerable extent, be attached to the roof, and obstructions to the free course of the water happen to close the ends of them, I have observed that purslain and other plants, far stronger than the mosses, take possession of the soil that accumulates in those places. Now it is evident that a well seasoned shingle cannot contain the nutritive juices formed in living plants: therefore, the means by which the mosses vegetate and subsist on the roof of a house, are very different from the manner in which Sir Humphrey Davy says the mosses subsist on trees, and the fungus on wheat. He tells us, "the fungus increases by the diffusion of its seed," and that "great care should be taken that no mildewed straw is carried in the manure used for corn." But his description of the injury done by it, seems to convey the idea that the fungus itself, (like an active insect) has the power of removing rapidly from stalk to stalk, *fixing itself* in the cells connected with the tubes, and extracting the juices of the plant; also *carrying away* and consuming this nutritive matter.

He says, "the fungus rapidly spreads from stalk to stalk, fixing itself in the cells connected with the tubes, and *carries away* and consumes that nourishment, which should have been appropiated to the grain."†

To this description of the fungus I can make no immediate reply, as I certainly do not understand, how or in which way these things can happen.

However, the growth of the mosses and other plants, on the roof of a house, clearly determines that the ingredients mentioned above are all gathered and employed in that instance, in the way which has been described, as the whole of them are readily seen and examined from the commencement to the end of the process. It is also equally evident that this vegetation exists and becomes luxuriant, without deriving any advantage from extracting the juices, that obtain in the cells and vessels of living plants.

"The analogy of nature is constant and uniform." Therefore, there seems to be sufficient reason to believe, that the same causes which introduce the mosses on the roof of a house, also cause them to grow on trees.

* After the covering of moss has promoted fermentation and decay in the shingles, they also furnish food for the plants.

† See his Agr. Chem. page 265.

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If nothing but the growth of the mosses were concerned in this theory, but little would have been said on this subject by me. But it seems highly important to the interests of agriculture, that farmers should be convinced, that decomposable animal and vegetable substances alone, furnish nutriment for plants of every description; and that these nutritious matters cannot be brought into active use, by any other process than fermentation and decomposition.

If these principles were firmly established, the numerous ways by which these substances are now uselessly destroyed or wasted, would be carefully avoided, and fermentation and decomposition would be so ordered and directed, as to produce the very important advantages, which may be readily obtained, by conducting these very interesting processes properly.

It appears that Sir H. Davy had, previously to making the following experiments, "supposed that fermentation was necessary to prepare the food for plants." He says, "I found from some experiments made in 1804, that plants introduced into strong fresh solutions of sugar, mucilage, tanning principle, jelly, and other substances died, but that plants lived in the same solutions after they had fermented; at this time, I supposed that fermentation was necessary to prepare the food for plants; but have since found the deleterious effect of the recent vegetable solutions, was owing to their being too concentrated; in consequence of which, the vegetable organs were probably clogged with solid matter, and the transpiration of the leaves prevented. In the beginning of June, in the next year, I used solutions of the same substances, but so much diluted that there was only one two hundredth part of solid vegetable or animal matter in the solutions. Plants of mint grew luxuriantly in all these solutions; but least so in the astringent matter. I watered some spots of grass in my garden, with the different solutions separately, and a spot with common water: the grass watered with the solutions of jelly, sugar, and mucilage, grew more vigorously, and that watered with the solution of tanning principle, grew better than that watered with common water.*

I cannot devise why these experiments should have altered or even shaken Sir Humphrey's previous opinion, "that fermentation was necessary to prepare the food for plants." Common practice, without the aid of chemistry, determines that too much nutriment, as effectually destroys vegetation, as does too little of it. This happens even when the solid parts of the nutriment have been divided by fermentation and decomposition; consequently rendered far more active, and less likely to clog or stop up the vegetable organs, than was the much more solid, undivided, and inactive matters used in a superabundance by him in his first experiment. It would also appear, the time required to determine the death of the plants, first put in the too powerful and inactive solutions, and placing other plants in the same ingredients, may have been sufficient to admit fermentation, not only to divide and expand their

* See his Lec. on Agr. Chem. pages 270 and 271.

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parts, but likewise to weaken them so much, that but little if any danger was to be expected from an excess of nutriment; or from "the vegetable organ being clogged, with any solid matters" that might remain undivided by this very important process.

This gentleman grew plants of mint in common water alone.* We know that water has the power of preserving the stems, leaves, and flowers of plants, even after they are separated from the living plant; therefore the water used to dilute the weaker solutions, was sufficient to preserve the life of the plants put into them, until fermentation took place. This must have been very soon, especially in June, as the weather in that month is commonly sufficiently warm to favour this process.

However, practice united with attentive observation clearly determines, that every cause which checks fermentation, (be that cause what it may,) checks vegetation also; likewise, that every cause which puts a stop to fermentation, produces the same effect on vegetation.

We may all see that plants seem to take an especial delight to feed on matters that are in the highest, and to us, the most offensive state of putridity. Thus we find that when night soil or other very rich substances, that become exceedingly putrid in a short time, are applied as manure, the plants soon become uncommonly vigorous, as well as unusually luxuriant.

That they have been organized to digest this matter is evident, as we find no more traces of it, in the vegetables grown where the plants have free access to the putrid matters, which are the most offensive to us, than in those grown in soils that have been greatly exhausted, and never manured by man. Whereas pure sand, clay, magnesia, the carbonate, phosphate, and sulphate of lime, &c. are found in their pure and unaltered state in the structure of plants.

But to return to the ivy and other creeping plants. They hasten the death of trees, by entwining round them; the air and heat of the sun is greatly excluded, and much injurious moisture confined. Fermentation, decomposition and decay, also naturally take place in those parts where the ivy, &c. are firmly attached to the tree. No question but they obtain some nutriment, from the decomposed matter formed in the wound, as they also do from the decaying vegetable matters, which gather and are confined at those places where the vine fastens itself to the tree. It is, however, evident, that these plants depend on the soil, for nearly all the food consumed by them, as they are equally healthy and vigorous when they run up, and attach themselves to stone walls.

Maize is a very large plant, consequently what happens to it is more readily seen. Now if this plant be wounded by injudicious cultivation, or in any other way, the sap commonly exudes from the wound, and it very often happens that a fungus is formed in and grows out of the part affected, and becomes very large.

* See his Lec. on Agr. Chem. page 271.

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The size of the wound increases with the growth of the fungus, and the stalk is corroded as far as the fungus becomes attached to it. I have often removed them, both before and after they had become very large. In some instances this has prevented the injury that is too commonly done by them. But, in general, they quickly grow out again, and eventually injure, or destroy the fruitfulness of the plant. However, I have never known extensive injury done by the fungus to a crop of maize; and but little of it would appear, if the plants were not wounded and mangled by an inconsiderate cultivation.

The mosses, as well as the weak and meager grasses and weeds which seem to be destined to follow them, are calculated to grow where more nutritive and robust plants cannot subsist; still from various causes they are often seen growing in much richer soils. However, the seed of the plants with which nature covers an old worn-out soil, after poverty has put a stop to the plough, may be generally conveyed by the agents mentioned above; or proceed from the seeds scattered over the ground, by the weak and meager plants, which nature found necessary to introduce, before the soil was capable of perfecting plants which were more robust. It appears that the vitality of seeds, in general, is preserved for ages, when buried beyond the power of germination, under the thick covering accumulated by the decaying vegetation grown on the soil. Also, that the decomposition which takes place, during a long course of perpetual ploughing and cropping, without attention to grass or manure, reduces this covering so much, that a sufficiency of heat and air is admitted to cause those seeds, which had remained inactive for ages, to vegetate.

This and other interesting facts connected with vegetation, were not long since explained by me in Mr. Poulson's paper; a copy of which, with some additions, will be hereafter inserted in this book.

I trust the inconsiderate and irrational opinions that have appeared on this very simple and obvious subject, will be sufficient to convince the reader, that although an intimate acquaintance with the theory of science, when united with native talents equal to the task, may fit a gentleman to write correctly, on subjects with which he is practically conversant and intimately acquainted; but little reliance can be placed on what he may gather from the discordant theories of others; as those theories which may happen to be most consistent with his own *uninformed* ideas, may also be the most erroneous; especially on subjects where the operations of nature are concerned. To become intimately acquainted with them, we must see how she acts, where the art of man does not oppose and thwart the simple, but correct economy, practised by her.

It should be also recollected, that however highly, and on the whole justly, a writer may be celebrated, if he advances any thing which is opposed to nature and reason, his name ought not to sanction the error.

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CHAPTER IV.

Gravitation does not, as has been asserted by some, "dispose the parts of plants to take a uniform direction;" nor do they "owe their perpendicular direction to gravity."* Neither is the sap raised by "the agency of heat, capillary attraction," nor the "contractions and expansions of the silver grain of the wood:" but by the living or vital principle in plants, acting in a temperature which favours the process.

It would answer no valuable purpose for me to explain, from the writings of others, the multiplied instances in which a marked analogy between plants and animals is seen. This has been extensively done by Dr. Darwin in his Phytologia, to which I refer the reader for interesting information on this subject; although it would seem that in some instances this gentleman has carried his analogy too far. Be this, however, as it may, what he advances seems to determine, that there is not a wider blank between the line which separates plants from animals, than there is between that which separates man from the inferior animals. The reasoning, reflecting, and calculating powers of the mind of man are amazingly extensive, when compared with any of the faint traces we see of similar principles in animals; and as the body of man has been calculated to act in unison with his superior mind, it very far surpasses that of the inferior animals.

If plants possess, even in a very limited degree, any traces of that sagacity which is so conspicuous in some animals, it has not been observed by me.

If we injure some animals that have neither power to resist nor to complain, it is evidently seen that motion is excited in them. It, however, requires scrutiny to observe even this in others. When some plants are injured, we see some feeble traces of similar effects.

Disease, wounds, age, plenty or lack of nutriment, produce effects in plants which are in many respects very similar to the effects produced by the same causes in animals.

Sir Humphrey Davy tells us, "gravitation has a very important influence on the growth of plants; and it is rendered probable, by the experiments of Mr. Knight, they owe the peculiar direction of their roots and branches almost entirely to this force."

To convince us of this, he says, that "a gentleman fixed some seeds of the garden bean on the circumference of a wheel, which, in one instance, was placed vertically, and in another horizontally, and made to revolve, by the means of another wheel, worked by water in such a manor that the number of revolutions could be regulated;

* See Sir H. Davy's Lec. on Agr. Chem. page 34.

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the beans were supplied with moisture, and were placed under circumstances favourable to germination. The greatest velocity of the motion given to the wheel was such, that it performed 250 revolutions in a minute; it was found that in all cases the beans grew, and that the direction of the roots and stems was influenced by the motion of the wheel. When the centrifugal force was made superior to the force of gravitation, which was supposed to be done when the vertical wheel performed 150 revolutions in a minute, all the radicals in whatever way they protruded from the position of the seeds, turned their points outward from the circumference of the wheel, and in their subsequent growth receded at right angles from its axis; the germins, on the contrary, took the opposite direction, and in a few days their points all met in the centre of the wheel."

"When the centrifugal force was made merely to modify the force of gravitation in the horizontal wheel, where the greatest velocity of revolution was given, the radicals pointed downward about ten degrees below, and the germins as many degrees above the horizontal line of the wheel's motion, and the deviation from the perpendicular was less in proportion, as the motion was less rapid."

"These facts afford a natural solution of the curious problem, respecting which different philosophers have given such different opinions; some referring it to the nature of the sap, as De La Hire; others, as Darwin, to the living powers of the plant, and stimulus of the air upon the leaves, and moisture upon the roots: the effect is now shewn to be connected with mechanical causes, and there seems to be no power in nature to which it can with propriety be referred but gravity, which acts universally, and which must tend to dispose the parts to take a uniform direction."*

Animate, as well as inanimate nature is influenced by gravitation; but before Sir H. ascribed such incredible powers to it, he should have explained the phenomenon; especially as nothing more nor less can be gathered from Mr. Knight's wheels, but that force may counteract the usual course of nature, either more or less as the force may happen to be applied.

Plants have not been subjected more, if as much, to the laws of gravitation as animals. It is not only pleasing, but even surprising, to reflect on the various methods and postures which we use to retain the centre of gravity, or to recover it when lost, without our being *sensible of it.* "Thus we bend our bodies forward when we rise from a chair, or when going up stairs; and for this purpose a man leans forward when he carries a burden on his back, or backwards when he carries it on his breast; and to the right or left side, as he carries it on opposite sides."† Now, those, and very many other things done by us, without thought or reflection, are as much the efforts of the living principle that animates our bodies, as are the actions which require thought and deliberation; therefore, as a plant is confined to one spot, thought and reflection do not seem

* See his Lec. on Agr. Chem. page 32 to 34.
† See vol. ii. Elem. of Sciences and Arts.

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to be necessary to it. The sagacity necessary to the well being of an active animal is not seen in the oyster.

When heavy rains or other causes lodge or lay down our crops, the economy of the plants is more or less injured; still they commonly become after this, sufficiently erect to produce more or less fruit. If the vital or living principle in the plant cannot raise the more ponderous parts of it, a crook is formed at the extremity of that part of the plant which cannot be raised. From which point so much of the plant, as can be raised by the living principle within it, takes an ascending direction. In this case it is clearly seen that gravity in place of "disposing the parts of plants to take a uniform direction," is in most instances opposed to it. It is gravity that confines that part of the plant, which cannot be raised in immediate opposition to it, by the powers of life in the plant.

Here the analogy between the action of the living principle which animates plants, and that which animates animals, is powerfully enforced. After a disease has been entirely removed, and the patient excersises all his reasoning faculties, it often happens, that he cannot remove himself from the spot on which he lies, or even turn from side to side; or raise himself up in his bed. The cause of this is evident; disease has weakened his system so much, that he has not sufficient force or strength, to overcome the power of gravity, which confines the more ponderous parts of his body to the bed on which he lies; although he may be able to raise his hands and arms, or remove his feet and legs, as it requires much less power to do either. Still those much less powerful efforts are dependent on animation; for no more power exists in a lifeless corps than in the dead body of a tree.

Gravitation acts uniformly, and is only to be overcome by superior force. This force may be natural, artificial, or accidental, or formed by a combination of these causes.

In clearing off grounds in the back woods, we sometimes observe, that the exceedingly heavy trigger of a dangerous trap is kept in its place by gravitation. When the bodies of some trees which were blown down, and had lain on the ground for a considerable time, are cut off, the stumps, be they long or short, immediately assume their original upright posture. It appears, when this happens, the roots next to the direction in which the tree falls, were not broken by the fall of it; and the bend made in them by the falling of the tree forms powerful springs; also that gravity confines the ponderous trigger attached to the trap, until art has removed it by the axe.

When a ditch is made on a line separating a field from an adjoining wood, the lateral roots of the trees which had run into the latter, are cut off. New roots are quickly formed by the living principle in the tree. These take their usual lateral direction through the soil, until they approach near the ditch. Here the root acts as if instructed by some intuitive principle, (which we do not, and perhaps cannot clearly comprehend,) not to expose its young and

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tender fibres to the destructive influence of the open air, and scorching rays of the sun, and as if it had power to avoid the injury; for at this point it forms an angle, and turns downward, and also keeps at that distance from the surface of the side of the ditch which seems well calculated to secure that portion of heat, moisture, and air, which accords best with the economy of it. After the root has proceeded downwards somewhat deeper than the bottom of the ditch, a second angle is formed, and it crosses the ditch at a proper distance from the surface of it. Here a third angle is formed, under the side of the ditch next to the field, and the root progresses upward in direct opposition to gravity, until it comes in contact with the soil which is capable of supplying it with sufficient nutriment. Here this well informed traveller, forming a fourth angle, and the roots and fibres growing from it, spread themselves through the soil, at that distance from the surface, which nature had formed them to inhabit.

It is also often seen that the roots of trees have crossed very deep and wide gullies in the same way. When the gullies have become sufficiently wide to carry off the water readily, grass and other vegetation calculated to prevent washing, accumulate on the bottom and sides of them.

The tap roots of plants grow downwards, and some of them to a great depth. How they have been formed to thrive and flourish so far from the surface of the soil, and where we do not observe that any nutriment for plants obtains, is a difficult question. Still as we may see that those roots supply the upper part of the structure of plants of this description, with so much moisture during a dry time, that they continue green and luxuriant, when plants without tap roots are suffering very much by drought, there is every reason to believe that the lateral roots, and other organs of plants of this kind, which have been formed to gather nutriment, and placed where it abundantly obtains, are so much invigorated by this highly important supply of moisture, as to be enabled to gather much more nutritious matter, during a dry time, than could be otherwise done. Now if this be granted, it is by no means difficult to suppose, that plants of this kind have been so constructed, that a sufficiency of this nutriment, together with other ingredients, may be readily conveyed by the upper structure of the plant, to that part of it which grows deep in the inert earth, where but little if any nutriment obtains.

Be this, however, as it may, long practice and observation seem to determine, that lateral roots cannot live, if they be buried so deep in the ground as to exclude a due proportion of heat, nutriment, and atmospheric air: also, that the living principle in plants makes powerful efforts to place their lateral roots at a proper distance from the surface.

This is seen when seeds (such as wheat, &c.) which do not form tap roots, are buried too deep for lateral rooted plants to prosper. Although the seed may vegetate and form sufficient roots to keep

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the plant alive for a time, it is feeble, and grows slowly, until the vital principle in the plant has formed another set of roots at a proper depth within the surface of the soil. After this has been done, decomposition separates the first set of roots from the plant, just underneath the spot where the last set of roots is formed.

The same often happens, when trees are planted so deep in the inert earth, that the energetical power of life is not sufficient to enable the roots to rise up and take possession of the soil in which nature had constructed them to grow. In this case, unless the system of the plant has been too much injured and debilitated by the removal of it, the powerful principle of life causes a new set of roots to be formed, at that distance within the surface of the soil, which best suits the nature and properties of the plant.

But to come still nearer to the point. When a tree grows on the side of a very steep and high hill, does gravity cause the lateral roots "to take a uniform direction?" Certainly not. If this were the case, the lateral roots next to the declivity would branch out into the air. While those on the side next to the hill would be compelled to grow horizontally, and bury themselves deep in the inert earth.

Happily for us, vegetation does not depend on theories, but on nature, and the living principle in plants. These direct, and also enable, the lateral roots to ascend and descend a steep and high hill, at a proper depth within the surface of the soil. This is done in a way which is very analogous to that pursued by the mole, when it ascends and descends a steep and high hill, in search of the food which had been provided for it.

Where stones, or other obstacles, obtain, the mole has to exercise his sagacity, and patiently encounter the labour arising from burrowing over, under, or round them, as may best suit his purpose.

Now it seems evident, that the lateral root pursues its course much in the same way, and for the same purpose, and in every respect performs the part which nature has assigned it to act on the theatre of life, quite as well as does the mole.

It would, however, appear, that, as Sir H. Davy cannot so readily see the action of the springs which are set in motion by the energetical powers of life in a plant, or the cause which teaches, inclines, or induces it to act in unison with its structure and organization, as he does the causes which enable, and the instinct which teaches, inclines, and induces an animal to act in unison with its structure and organization, he denies that plants are animated by the vital principle, and attributes what is done by this principle in them, to gravitation, and other physical causes.

It is said that the falling of an apple from a tree, suggested to Sir Isaac Newton the rudiments of gravitation. But be this as it may, it would be very difficult to believe, that the same physical cause which occasioned this, or any other apple, to fall to the ground, also caused the body and branches of the tree on which it grew to ascend up into their native element.

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It is really wonderful that Sir H. did not think of this; especially as he has very judiciously informed us, that "life gives a peculiar character to all its productions. The power of attraction and repulsion, combination and decomposition, are subservient to it." Now if this be admitted, every difficulty which has been set in motion, either by Mr. Knight's wheels, or whirly-gigs, or by French philosophy, as it is now called by some, vanishes. For, agreeably to this rational theory, life, in its lowest grade, acts independently of every thing, except the will of the Deity, who is the essence and fountain of life; and who, for reasons which seem to be wise and benevolent, but best known to himself, has caused this powerfully self-moving principle to animate organized matter; and through the medium of this organization, to perpetuate and multiply itself, in the various forms and grades of animals and plants in which it was first made to exist.

But it would seem that the effects produced on Sir H.'s imagination by the rapid motion of Mr. Knight's wheels or whirly-gigs, or (if Bailey's definition of a whirly-gig be correct,) "playthings turning round," have induced him to believe, that "animation, is limited to beings possessing the means of voluntary locomotion."

He says that, "In animal systems, the heart and arteries are in constant pulsation. Their functions are unceasingly performed in all climates, and in all seasons; in winter as well as in spring, upon the arctic snows, and under the tropical suns. The power is connected with animation, is *limited* to beings possessing the means of voluntary locomotion; it exists with the first appearance of vitality; and disappears with the last spark of life."*

Thus it appears that this gentleman, not content with controverting the theory of the animation of plants, advances further, and would seem to say that many animals themselves are not possessed of animation.

There is a great variety of animals which do not "possess the means of voluntary locomotion." The common use of the oyster, however, has made many better acquainted with it, than with most other animals, who have no more power to remove from one place to another than plants. To keep oysters alive, when removed from their native element, water, in which salt has been dissolved, is sprinkled over them. The noise made by them in taking in this refreshment is so loud and continued, as not to escape the notice of even an inattentive observer. If a living oyster be removed from its shell, the pulsation of its heart, is often seen for some time after it has been laid in a plate.

We have just as much reason to question the vitality and animation of the active monkey, as that of the oyster. If it were possible to prove that the oyster did not possess vitality, and had been subjected to the laws that govern dead or inanimate matter, it

* See his Lec. on Agr. Chem. page 249.

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might also be readily proved, that not only the monkey, but also man, had been subjected to the same laws.

Sir Humphrey informs us, that "The root of the vegetable is its organ of nourishment, by which it imbibes food from the soil. The root may be said to be a continuation of the trunk terminating in minute ramifications and filaments, and not in leaves; by burying the branches of certain trees and elevating their roots, the roots produce leaves, and the branches radical fibres and tubes."*

"The wood of trees is composed of an external *living* part, called alburnum or sap-wood, and an internal or *dead* part, the heart-wood." "The alburnum is white and full of moisture, it is the great vascular system, through which the sap rises; and the vessels in it extend from the leaves to the minutest filaments in the roots."†

"In the leaves, much of the water of the sap is evaporated; it is combined with new principles fitted for its organizing functions, and probably passes, in its prepared state, from the extreme tubes of the alburnum into the ramifications of the cortical tubes, and then descends through the bark."‡

"There are in the arrangement of the fibres of the wood, two distinct appearances; there is a series of white shining laminæ, which shoot from the centre to the circumference, and these constitute what is called the silver grain of the wood. There are also numerous series of concentric layers, which are usually called the spurious grain, and their number denotes the age of the tree." "The silver grain is elastic and contractile, and it has been supposed, by Mr. Knight, that the change of volume produced in it by the change in the temperature is one of the principal causes of the ascent of the sap. The fibres of it seem *always* to expand in the morning, and contract at night; and the ascent of the juices, depends principally on the agency of heat.

"The silver grain is most distinct in forest trees; but even annual shrubs have a system of fibres similar to it. The analogy of nature is constant and uniform, and similar effects are usually produced by similar organs."

"The pith occupies the centre of the wood; its texture is membraneous; it is composed of cells, which are circular towards the extremity, and hexagonal in the centre of the substance. In the first infancy of the vegetable, the pith occupies but a small space. It gradually dilates; and, in annual shoots and young trees, offers a considerable diameter. In the more advanced age of the tree, acted on by the heart-wood, pressed by the layers of the alburnum, it begins to diminish, and in very old forest trees disappears altogether."§

* See his Lec. on Agr. Chem. page 56. † Idem, pages 59 and 60.

‡ Idem, page 64.

§ Old age causes the organization of animal as well as vegetable systems to become imperfect. The interior parts of very old trees are more frequently found hollow than that of younger ones. In either of those cases, as the mid-

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In the second lecture, to which Sir H. above refers, and in which he tells us he had "stated that the ascent of the sap depends principally on the agency of heat;" he says, "The influence of the changes of seasons, and of the position of the sun on the phenomena of vegetation, demonstrate the effects of heat on the functions of plants. The matter absorbed from the soil must be in a fluid state to pass into the roots. The activity of chemical changes, likewise, is increased by a certain increase of temperature, and even the rapidity of the ascent of the fluids by capillary attraction.

"This last is easily shown, by placing in each of two wine glasses a similar hollow stalk of grass, so bent as to discharge any fluid in the glasses slowly, by capillary attraction; if hot water be in one glass, and cold water in the other, the hot water will be discharged much more rapidly than the cold water."* He again observes, that "The attraction of cohesion, sometimes called capillary attraction, enables fluids to rise in capillary tubes. This attraction like gravitation, seems common to all matter, and may be a modification of the same force;† like gravitation, it is of great importance in vegetation. It preserves the forms of the aggregation of plants, and it seems to be a principal cause of the absorption of the fluids by their roots.‡

It is difficult to follow Sir H. through the different theories he forms respecting the ascent of the sap. In his second lecture, he seems to refer it to the agency of heat, and capillary attraction. In his third lecture, as may be seen by the foregoing quotation from it, he adds to the theory formed in his second lecture, the advantages which he then seems to expect from the supposed "regular expansions and contractions of the silver grain of the wood;" but at the same time asserts, that "the ascent of the sap, as was stated in the last lecture, depends principally on the agency of heat."

He seems, however, to have discovered, after this, that neither the agency of heat, nor capillary attraction, nor the regular expansions and contractions of the silver grain, were sufficient to raise

die of the tree has sunk into decay, the pith and very frequently the heart-wood, disappear, as far as the decay has extended. See his Lec. on Agr. Chem. pages 60 and 61.

* Here Sir H. seems to labour hard, by "the effects of heat on the functions of plants," together with his hollow stalks of grass, and hot water, to substantiate his first theory, "the ascent of the sap depends principally on heat.—See his Lectures on Agr. Chem. page 38.—Idem, page 35.

† That is, it may or may not be a modification of the same force, for aught Sir H. or any other person, knows to the contrary of either.

‡ It may preserve the forms of the aggregations of the parts of the dead and inanimate matter. It is, however, evident, that it is the powerfully living principal in plants that preserves the forms of the aggregations of them, as they crumble into pieces when this principle no longer exists in them; here again the analogy between plants and animals is strikingly great.

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the sap. For he again changes his theory, and tells us in his fifth lecture, "The powers which cause the ascent of the sap have been slightly touched upon in the second and third lectures. The roots imbibe fluids from the soil by capillary attraction; but this power alone is insufficient to account for the rapid elevation of the sap into the leaves. This is fully proved by the following fact, detailed by Dr. Hales, in his first volume of the 'Vegetable Statics,' page 114. A vine branch of four or five years old was cut through, and a glass tube carefully attached to it; this tube was bent as a siphon, and filled with quicksilver; so that the force of the ascending sap could be measured by its effect in elevating the quicksilver. In a few days it was found, that the sap had propelled forwards with so much force, as to raise the quicksilver to thirty-eight inches, which is a force considerably superior to that of the usual pressure of the atmosphere. Capillary attractions can only be exerted by the surfaces of small vessels, and can never raise a fluid into tubes above the vessels themselves."

"I referred in the beginning of the third lecture to Mr. Knight's opinion, that the contractions and expansions of the silver grain in the alburnum are the most efficient cause of the ascent of the fluids contained in the pores and vessels.* The views of this excellent physiologist are rendered extremely probable, by the facts he has brought forward in support of them. Mr. Knight found that a very small increase of temperature was sufficient to cause the fibres of the silver grain to separate from each other, and a very slight diminution of heat produced their contraction. The sap rises most vigorously in spring and autumn, at the time the temperature is variable; and if it be supposed, that in expanding and contracting, the elastic fibres of the silver grain exercise a pressure upon the cells and tubes, containing the fluid absorbed by the capillary attraction of the roots, this fluid must constantly move upwards towards the points where a supply is needed."

* Sir H. does tell us in the beginning of the third lecture that "The silver grain is elastic and contractile, and it has been supposed by Mr. Knight, that the change of volume produced in it by change of temperature, is *one* of the principal causes of the ascent of the sap." But as if determined to be clearly understood that heat was the principle agent employed in this process, he immediately says, "The fibres of it (that is of the silver grain) seem always to expand in the morning and contract at night; and the ascent of the juices, as was stated in the last lecture depends principally on the agency of heat.

Why Sir H. does not seem to know or say that he has changed the "principal" or "most efficient" cause of the ascent of the sap, and also his theory of the expansions and contractions of the silver grain is unknown to me. Both of these changes, however, have been made by him In his second lecture he tells us "The fibres of it (that is of the silver grain) seem *always* to expand in the morning, and contract at night." But in direct opposition to this marked regularity in the contractions and expansions of the silver grain he forms a theory in his fifth lecture, by which it would appear he wishes us to believe that the sap is raised by the variable and irregular "expansions and contractions of the elastic fibres of the silver grain."

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"The experiments of Montgolfier, the celebrated inventor of the balloon, have shown that water may be raised almost to an indefinite height by a very small force, provided its pressure be taken off by continued divisions in the column of fluid. This principle, there is great reason to suppose must operate in assisting the ascent of the sap in the cells and vessels of plants which have no rectilineal communication, and every where oppose obstacles to the perpendicular pressure of the sap."*

The wonderful mechanism of the human system ought to have convinced Sir H., that nature had not been so deficient in the organization of plants as that "every where obstacles oppose the perpendicular pressure of the sap:" especially as he says, "the analogy of nature is constant and uniform, and similar effects are usually produced by similar organs."

In fact, fifty years ago, every schoolboy in the little village where I was born, knew full well that no obstacles existed to prevent the pressure of the sap through the pores in the wood. Before the novelty ceased to surprise, some boys were in the habit of taking others, who had not seen the experiment tried, to a cooper's shop, to convince them that they could blow their breath through a stave, from one end to the other of it.

The young philosopher wetted one end of the stave with his spittle. By placing the other end in his mouth and blowing, the spittle was immediately seen by his astonished pupil to form bubbles of various sizes, which rose and fell in very rapid succession, as long as the experimenter could continue the blast.

The astonishment, however, of the novice ceased, as soon as he had reflected, that he had often seen the sap exuding from the ends of green wood exposed to the sun, or more intense heat of a fire. This convinced him that the pores in the wood, through which the breath of the learned boy had passed, had been formed by nature for the circulation of the sap.

However, as fifty years had elapsed since I had seen this experiment tried, the stave of an old flour-barrel was cut off this morning, at each end, near to the inner side of the groove in which the head was fastened, and the experiment conducted as it was when I was a boy: the result was the same.

The wood of the stave last employed was oak, as was that of the staves used fifty years ago; not of the kinds which form a very close grain. The pores of these, and several kinds of wood, become too compact after they have been much compressed by being seasoned, to admit air to be blown through them by the mouth, and while they are green, and the pores filled with sap, this fluid would oppose the progress of the air, unless the force employed were very great.

It may be probable, that if the green wood were immersed in water until the sap were soaked out, and after this, very quickly

* See his Lec. on Agr. Chem. pages 239, 240, and 241.

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dried, that air might be blown by the mouth through the pores of many of the close grained woods. This is, however, of no consequence, as "the analogy of nature is constant and uniform, and similar effects are usually produced by similar organs."*

Having proved that nature has not introduced obstacles opposed to the ascent of the sap. I beg leave to observe, that Sir H. in his third lecture, when endeavouring to prove that "the ascent of the sap depends principally on heat," says, "the fibres of the silver grain seems *always* to expand in the morning and contract at night."† This is certainly expressive of a very marked regularity. He, however, contradicts this in his fifth lecture, when about to form a very different theory; to wit, resting principally on the frequent expansions and contractions of the silver grain. He then says, "The sap rises most vigorously in the spring and autumn, at the time the temperature is not variable; and if it be supposed that in expanding and contracting the elastic fibres of the silver grain exercise pressure upon the cells and tubes, containing the fluids absorbed by the capillary attraction of the roots, this fluid must constantly move upwards towards the points where it is wanted."

Now, Sir H. ought to have recollected, before he promulgated this hypothesis, that he had neither proved, nor even made it appear probable, that the roots absorbed fluids from the soil by capillary attraction; nor pointed out any probable force by which the sap was pressed upwards; nor described the divisions in the column that take off the pressure.

For if it were admitted that the aerial voyager (with whom it would seem Sir H. had suffered his imagination to soar too high) be correct, in saying that "water may be raised to almost an indefinite height by a very small force, provided its pressure be taken off by continued divisions in the column," the force must be applied, and the divisions in the column must exist, before the water can be raised.

It is really wonderful that Sir H. after being so clearly informed by Dr. Hales, that the running of the sap was not only checked during those changes in the temperature, but that it also descended and remained quiescent, until the temperature favoured its rising, should assert that the sap rises most vigorously at the time the temperature is variable.

It would, however, seem that Sir H. could not devise, or has forgotten to tell us, by what power "the sap is pressed upwards," when the silver grain (as very often happens,) regularly expands in the morning and contracts at night; and at which time, if the weather be neither too cold nor too hot, and be also clear, the sap flows with a much greater rapidity and regularity than at any other time, as will be explained presently.

If, however, the silver grain did expand and contract as regularly and as frequently as the pendulum of a clock vibrates, it would

* See Sir H. Davy's Lectures on Agr. Chem. page 61.
† Idem, page 61.

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seem that the sap would descend, if no power superior to gravitation intervened. This is confirmed by Sir H. himself, who says, "The motion of the sap through the bark seems principally to depend on gravitation. When the watery particles have been considerably dissipated by the transpiring functions of the leaves, and the mucilaginous, inflammable, and astringent constituents, increased by the agency of heat, light and air, the continued impulse upwards from the alburnum, forces the remaining inspissated fluid into the cortical vessels, which receive no other supply. In these, from its weight, its natural tendency must be to descend; and the rapidity of the descent must depend upon the general consumption of the fluids of the bark in the *living processes of vegetation;* for there is every reason to believe, that no fluid passes into the soil through the roots; and it is impossible to conceive a free lateral communication between the absorbent vessels of the alburnum in the roots and the transporting or carrying vessels of the bark; for if such a communication existed, there is no reason why the sap should not rise through the bark as well as through the alburnum; for the same physical powers would operate upon both."*

Now, certain it is, that the parts of the bark through which the cortical vessels pass, seem to be far more elastic and contractile than the silver grain of the alburnum, and no question but the expansions and contractions of it are at least quite as extensive. Why then should not the fluid in the cells and vessels in the alburnum, from its gravity, its natural tendency, be compelled to descend, as well as that in the vessels of the bark, if no power superior to "common physical agencies" caused it to ascend? "for the same physical powers would operate upon both."

I would also observe, that here again Sir H. has entrapped himself, as will every gentleman, be his talents what they may, who attempts to prove there is "nothing above common matter in the vegetable economy."

He tells us, that "the rapidity of the descent, (that is, of the fluid in the cortical vessels,) must depend principally upon the general consumption of the fluid of the bark in the *living processes* of *vegetation.*"

Now, I believe there are few men, who have given but common attention to what passes in their own system, who would readily believe, that the "living processes" employed in the animal economy, such as the circulation of the "fluids," or blood, were more confirmatory of vitality and "animation" than are the "processes" of digestion, chylification, or the extensive application of the nutriment on which animals live. Here again the analogy between plants and animals is very conspicuous.

If plants have been subjected to the same laws that govern dead matter, how does it happen that early in the spring when the buds are yet small, and present but a very limited surface to be acted

* See his Lec. on Agr. Chem. pages 244 and 245.

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upon by the feeble ray of a distant sun, and when the ground is deeply covered with snow, that the sap runs freely from the sugar tree through the day? This uniformly happens, if the days are generally clear, and but moderately warm for the season, and the nights sufficiently frosty and cold to congeal the surface of the snow, or any part of the ground which may happen to be uncovered. Much sugar is made if this state of the weather generally exists during the season for making this article.

The cause of this seems evident. If the variations in the temperature, and changes in the atmosphere, with regard to dryness and moisture, happen to be frequent, it appears that the organs of the tree are so sensibly affected by those changes, (after the pores and vessels have been expanded by the powerful principle of life, acting in a temperature which had been previously favourable to the action of it,) that the ascent of the sap is frequently retarded and checked, and so often descends, that but little of it runs out from where the trees have been tapped.

As nature is ever vigilant to promote the interest of vegetation to the utmost extent, she is continually applying the little sap which circulates, while this unfavourable temperature continues, to the growth and expansion of the buds which form the leaves and flowers of the plant; and perhaps is also hoarding up rich matters (as it is supposed she does in the case of the grasses,) for forming the seed.

These facts are so notorious that the farmers in my neighbourhood, and so far as my information extends, every where else, where the sugar tree is in plenty, have often to complain, that the season for making it has been so unfavourable, that much time has been expended in this business to but very little purpose.

To cast further light on this subject, I will transcribe a quotation made by Sir H. from Dr. Hales: "It is impossible to peruse any considerable part of the 'Vegetable Statics' of Hales, without receiving a deep impression of the dependence of the motion of the sap upon common physical agencies. In the same tree, this sagacious person observed that in a cloudy morning when no sap ascended, a sudden change was produced by a gleam of sunshine, of half an hour; and a vigourous motion of the fluid. The alteration of the wind from south to north immediately checked the effect. On the coming on of a cold afternoon after a hot day, the sap that had been rising began to fall. A warm shower and a sleet storm produced opposite effects."*

This, on the whole, is very expressive of what occurs when the season for making sugar happens to be precarious; except that the tree is sometimes so sensibly affected by the heat of the sun in the middle of the day, that the rising of the sap is greatly depressed, or else entirely suspended.

It appears that Dr. Hales supposed, that "the pith was the great

* See Sir H. Davy's Lec. on Agr. Chem. page 248.

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cause of the expansion and development of the other parts of the plant; that being the most interior, it was likewise the most acted upon by all the organs, and that from its reaction the phenomena of their development and growth resulted."*

I have not seen Dr. Hales's "VegetableStatics," but as we are indebted to him for the important experiments made on the branches of the vine and apple tree, to determine the force of the ascending sap; and every thing quoted from his writings by Sir H. seems to determine that he was a judicious and very attentive observer of the economy of plants, it would be difficult for me to believe that he could suppose, that the action and reaction which he believed took place between the pith and other parts of a plant, could proceed from a power residing in inanimate organized matter; or that there "seemed to be no other power to which this can with propriety be referred but gravity, which acts universally," and which Sir H. also says, "must tend to dispose the parts to take uniform directions."†

Be this, however, as it may, it would seem that after Sir H. had read or better considered, the result of Dr. Hales's experiment upon the branch of the vine, he was convinced that his system, founded on the agency of heat, capillary attraction, and on "the fibres of the silver grain *always* expanding in the morning, and contracting at night,"‡ had been built on a sandy foundation. Certain it is, that immediately after quoting this experiment, his system is changed. It would also seem, that he was very erroneously led to believe, that what Dr. Hales says of the frequent fluctuation in the ascent and descent of the sap, was greatly in favour of his new theory, founded on the frequent "expansions and contractions of the silver grain," in consequence of the "variable temperature which occurs in spring and autumn."§

It has, however, been clearly demonstrated by actual and very extensive practice, that in place of the sap rising most vigorously, when the temperature is variable, it actually ceases to flow freely, and often descends. This fact is so obvious, where sugar is made that not only every farmer engaged in making it, but also every boy or girl who assists him in the business, can generally readily tell, by the state of the weather, before they examine the result, whether the sap has or has not run freely, since they last visited the trees.

This, as well as most other things, seems to determine, that there is scarcely any thing in nature so simple and obvious, that it does not require practical observation to become well acquainted with it: also, that those who write for the express purpose of teaching others, should first become practically and intimately acquainted with the subject they mean to elucidate.

* See Sir H. Davy's Lec. on Agr. Chem. page 62. † Idem. page 34.
‡ Idem, page 61. § Idem, page 240.

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That plants are more tenacious of life than animals, and have been better organized to preserve and propagate it, is evident. If a green pole, formed from some kinds of wood, be used as a rail, it often vegetates and produces branches and leaves, before the living principal is destroyed. Or if it be used for a stake, roots are formed; and if it be suffered to remain, it becomes a tree. Plants propagate their species from their branches and roots, as well as from seed. If a branch be separated from a tree, and properly placed in water, the vital principle in it is preserved for some time.

This is seen in the branch of the apple tree immersed in water by Dr. Hales. Of it Sir H. says, "A branch from an apple tree was separated, and introduced into water, and connected with a mercurial gauge. When the leaves were upon it, it raised the mercury by the force of the ascending juices four inches; but a similar branch, from which the leaves were removed, scarcely raised it a quarter of an inch."*

Now if the power in the leaves alone to raise the sap was in this experiment more than is sixteen to one, I cannot see why Sir H. should tell us, that "the ascent of the juices depends principally on heat;" or, that "the contractions and expansions of the silver grain are the most efficient cause of the ascent of the fluids;" or, "in calling forth the vegetable functions, common physical agents alone seem to operate; but in animal systems, those agents are made subservient to a superior principle;" or, that "we must not suffer ourselves to be deluded by the very extensive application of the word *life*, to conceive any power similar to that producing life in animals. To give the argument, in plainer language, there are few philosophers who would be inclined to assert the existence of any thing above common matter, any thing immaterial, in the vegetable economy and for reasons nearly as strong, *irritability* and *animation* ought to be excluded."†

The word immaterial is used to convey different ideas; therefore using this word as it has been used in the present instance by Sir H. does not appear to give the argument in plainer language.

If this gentleman means "there are but few philosophers who would be inclined to assert the existence of any thing in the vegetable economy," similar to that highly exalted principle in man which in all ages, and under every system and form of religion, has enabled him to extend his views beyond his present mode of existence; and which good and pious men living under the dispensation of the Gospel inform us, may be extended so far as to obtain on this side of the grave, a happy assurance of immortality and eternal life, there are certainly but few philosophers who would *assert* that this is seen in the vegetable economy, or even in the economy of the inferior animals. The sagacity of some of the lat-

* See his Lec. on Agr. Chem. page 241. † Idem, page 250.

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ter is astonishingly great: still we do not observe that they have the power to extend their views further than their present mode of existence. There have been, however, a multitude of philosophers, and wise ones too, who assert the existence in the vegetable economy of a principle far above "common matter." As none of them have written more correctly on the chemical subjects connected with agriculture than has Sir H. Davy, when he confines himself to subjects which long practical observation had rendered familiar to him, I will quote again his own words; as it would be impossible for me to select any that are better calculated to substantiate this very interesting fact: to wit, "The same accuracy of weight and measure, the same statistical results which depend on the uniformity of the laws that govern dead matter, cannot be expected in operations where the powers of life are concerned, and where a diversity of organs and functions exists. The classes of definite inorganic bodies, even if we include the crystalline arrangements of the mineral kingdom, are few, compared with the forms and substances belonging to *animated* nature. Life gives a peculiar character to *all* its productions; the powers of *attraction* and *repulsion*, *combination* and *decomposition*, are subservient to it."*

Now, it is strange that, after applying this expressly to plants in his second lecture, this gentleman should, either from forgetfulness or some other cause, assert, in his fifth lecture, "that in calling forth the vegetable functions, common physical agents alone seem to operate; but in animal systems, these agents are made subservient to a superior power." Also, that "few philosophers would assert that any thing above common matter exists in the vegetable economy." Likewise, that "animation ought to be excluded."† Although it may be seen from the above quotation, that he previously considered plants as "belonging to *animated* nature."

* See his Lec. on Agr. Chem. page 54. † Idem, page 250.

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CHAPTER V.

It is shown that men and other animals are quite as much, or probably more, affected and injured, by changes in temperature, than plants are. Also, that the suspension or languid action of the living principle in trees, during winter, furnishes no just cause for questioning their vitality or animation. The sleep or folding-up of the leaves of plants at night, (as usually described,) appears to be a mistaken theory; as it would seem, that the leaves of plants fold or curl up through the heat of the day, more generally than they do through the night The animation and sensibility of plants is considered. It is also shown that the small size of the pores in the roots and radical fibres of plants, is a wise provision of nature.

I TRUST it will clearly appear, from what has been advanced in the foregoing chapter, that gravitation does not "dispose the parts of plants to take a uniform direction." Also, that the sap is not raised either by the agency of heat, capillary attraction, or the expansions and contractions of the silver grain of the wood, but by the living principle in plants, acting in a temperature which favours the process.

Nature has caused plants to grow in every climate where vegetation can exist. As they have no power to remove from one place to another, and are continually exposed to the vicissitudes of the season, their structures have been formed to suit their peculiar situation, and the climates they have been destined to inhabit. Therefore, that degree of temperature which is most favourable to some of them, is injurious and often destructive to others. Most animals, however, are equally subjected to the same laws. Not only those that are as stationary as plants, and have no more power to skreen themselves from the vicissitudes of the climate, but also many of those that have the power to travel far, and sagacity to find, or with great ingenuity to form shelters, which skreen or defend them from the inclemency of the seasons. Many of this description become so much affected by difference in temperature, that they die when removed to some climates, which are very favourable to the existence of such animals as have been constructed to live in them.

Even man, who seems to have been destined to live in every climate where sufficient nutriment is to be obtained, cannot exist in many climates without encountering very considerable labour, in forming various conveniences to defend himself from the inclemency of the seasons, which, notwithstanding all his care and toil, often destroy him. How often are men and the inferior animals found dead, in consequence of venturing too far, or staying too long from the shelter afforded them by their huts, houses, dens, &c. It would appear, they could not exist in consequence of the absence of suffi-

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cient heat to form a proper temperature for the "pulsation of the heart and arteries," which, with the power of "locomotion" also, Sir H. seems to consider necessary to constitute vitality and animation.

We find, however, that though they possess those boasted powers, and a warm covering of wool, fur, hair, &c. animals are found frozen to death; while the trees and shrubs standing beside them remain unhurt, notwithstanding the organs of the latter are so very sensibly affected by the changes in temperature, which happen when they possess the power to display luxuriant vegetation. Now the cause of this hardihood through the winter seems evident. The frosts commence in the fall, and gradually increase until vegetation is locked up. The leaves are gradually affected, until they fall. The tender and very sensible pores, tubes and vessels of the tree, being affected by these changes of temperature, gradually contract, until sensibility is so much diminished, that the principle of life remains secure and uninjured through the winter, in consequence of the inactivity assumed by it.

This inactivity seems to confirm Sir H. in the opinion, that "Nothing above common matter exists in the vegetable economy." It forms, however, a very interesting display of the wisdom that has planned, and the power that has executed this very simple, but at the same time equally wise arrangement of nature; by which common physical causes become subservient to the purposes of *life*. If the destructive cold of winter were permitted to assume its utmost severity suddenly, and while the very sensible pores, vessels and tender organs of the tree are expanded, and freely exercising the hidden powers of life, (displayed to us by the animation produced by it,) death and destruction would follow. Life, however, like a well instructed general, finding itself closely pressed on every side, gradually retires within its fortress. In this it is preserved, by remaining inactive; until a change in temperature enables it to resume its former activity, with all the increased vigour naturally arising from this long rest; which, together with the much shorter and less perfect rest obtained by an excess of heat in midsummer, is no question one of the causes which enables trees to live much longer than do animals. The organs of the latter are continually kept in full motion, until so many parts of the machinery composed of common matters, is so much worn or exhausted, by the friction of perpetual motion, that they cannot perform their functions, and death ensues.

We are told that a rest very similar to that obtained by cold for trees, &c. in northerly climates, is also obtained in very warm ones, by an excess of heat, joined with a deficiency of moisture. This seems the more probable, as we see, even in our climate, that in midsummer, heat causes the circulation of the sap to progress so very tardily, that the bark adheres closely to the sap wood of the tree: also that heat and drought united, act much in the same way, on more tender vegetation, as frost does. It is evident that plants

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have not been subjected to common physical causes more than man. The destruction of the latter by exposure to intense heat or severe cold is trivial indeed, when compared with the multitudes who are daily cut off in the prime of life, merely by not being careful to guard against the consequences arising from a sudden change of temperature alone.

Thus we see that heat and cold produce very similar effects on the organs of plants and animals, and that in these respects the analogy between them is very obvious.

Although it has not been demonstrated, it is believed by Sir H. and many other gentlemen, that the leaves on evergreen trees and shrubs are kept alive through the winter by a languid circulation of the sap. It would therefore appear, as the result proves that deciduous trees live through winter, and powerfully exercise all the functions of life when a proper temperature will admit this to be done, that a languid circulation of the sap may also be kept up in them by the principle of life. However, this theory is by no means important, as it cannot be more difficult to imagine, that a tree may rest or sleep throughout the winter, without obtaining nutriment from the circulation of the sap, than that an active animal, accustomed to eat and drink as frequently, as do the animals who cannot live through the winter, without eating and drinking nearly the same quantity as they do in the summer, should be so constructed or organized, that it may and actually does sleep or rest without either eating or drinking through the winter. Or that the powers of life may be apparently suspended in the human body, notwithstanding the living principle still exists in it, and also acts with sufficient energy to prevent putrefaction, until it resumes its usual activity, although in many instances no apparent means have been employed to stimulate it into action.

It will be demonstrated in the next chapter, that the vitality of most kinds of seed is preserved for ages unhurt; when they have been favourably strewed over the soil, and also covered by nature beyond the power of vegetation.

Now if seeds have been so constructed that the living principle in them may be so long suspended, and after this brought into full and effectual motion or action, merely by being exposed to a favourable temperature, and planted at a proper depth in the soil, why may not the organization of trees and shrubs be so constructed, that the action of the living principle in them may be also suspended, and after this resume its full and effectual powers when the temperature favours the process?

We evidently see that the suspension of the vital principle in the eggs of the feathered race, in the spawn of fishes, and in the eggs of various other animals, does not (unless continued too long,) prevent it, when excited by a proper temperature, and other combining causes, from exercising all the powers of life and animation. Why, then, should Sir H. question that the action of the vital principle in trees may be also suspended, or caused to progress

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languidly, so long as may best suit the climate and economy of the plants; and after this, when excited by a proper temperature and other combining causes, resume the full powers of life and animation? In fact, there seems to be quite as much reason to question the one, as there is to question the other. The agency of common physical causes in either case, seems to be the same.

We are told by Sir H. Davy, that what Linnæus calls the sleep of the leaves, appears to depend wholly upon the defect of the action of light and heat, and the excess of the operation of moisture. Also, that "This singular but constant phenomenon had never been scientifically observed, till the botanist of Upsal was fortunately directed to it. He was examining particularly a species of lotus, in which four flowers had appeared during the day, and he missed two in the evening; he soon discovered that these two were hidden in the leaves which had closed round them. He took a lanthorn, went into his garden and witnessed a series of facts before unknown. All the simple leaves of the plants he examined, had an arrangement *totally* different from their arrangement in the day; and the *greater number* of them were seen *closed* or *folded together*."*

What may have happened in the garden of the botanist of Upsal, is unknown to me. However, from what I have observed in my own garden, where the useful plants common to the country are grown, I am disposed to believe that the "singular phenomenon of "the sleep of the leaves" has not yet "been scientifically observed." I find but two plants in my garden in which any visible alteration in the position of the leaves takes place at night.

The leaves of red clover generally turn their under surface uppermost at night, and resume the usual position in which they are seen in the morning, but I have observed that some of the leaves of this plant, in place of turning, defend their upper surfaces by two or more of them uniting their surfaces together. The English lambsquarter (so called here) raises up its leaves at night, so that the upper surfaces of opposite leaves come in contact, or nearly so, with each other.

I have observed that the leaves growing on the extremities of the younger branches of many trees and herbaceous plants, keep more or less folded or closed while young, and until they have attained some considerable size. These, however remain in the same position through the day as they do in the night, and gradually expand as their size increases, It would seem, however, that seeing those leaves folded at night, and not giving due attention to them in the day, has led to erroneous conclusions. Still, climate and the seasons may make a difference. My observations were made in the latter part of June, and fore part of July, when the nights were uncommonly cool for the season, and generally when the plants were very wet with dew.

Sir H. informs us, "The sleep of leaves is, in some cases, capa-

* See his Lec. on Agr. Chem. pages 65 and 66.

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ble of being produced artificially. Decandolle made this experiment on the sensitive plant. By confining it in a dark place in the day time, the leaves soon closed; but on illuminating the chamber, with many lamps, they again expanded. *So sensible* were they to the effects of light and radiant heat.*

Some animals are quite as sensibly affected by the same causes. The common farm yard fowl goes to roost in the middle of the day if the sun be considerably eclipsed; but awakens from its sleep, descends from its roost, and goes about as usual so soon as the cheering rays of the sun banish the gloomy appearance of untimely night. The owl and other animals hide themselves from the light, which seems to be as offensive to them as is darkness to others. The sensibility of the leaves of the sensitive plant is emphatically impressed by Sir H. who also says, "all leaves *elevate themselves* on the foot stalk during their exposure to the solar light, and as it were move toward the sun."† But, as if to blunt the edge of these facts, he tells us, "this effect seems, in a great measure, to be dependent upon the mechanical and chemical agency of light and heat.‡

Why then does he tell us, "the leaves *elevate themselves* and move toward the sun;" also, that the leaves of the sensitive plant were "*so sensible* of the effects of light and radiant heat?" After granting that leaves have the power to "move themselves," and that they are also "*sensibly* affected by the agency of light and heat," it is useless to attempt to lessen or abridge those powers. If they exist at all, animation, and a property sufficiently analogous to what is called irritability in animals, to answer all the purposes of life in plants, must also exist, notwithstanding Sir H. tells us, "we should not suffer ourselves to be deluded by the very extensive application of the word life, to conceive in the life of plants, any power similar to that producing the life of animals." Also, that nothing above common matter existed in the vegetable economy; and that "irritability and animation ought to be excluded."§ Now this same gentleman actually says, in another part of his book, that plants are "belonging to animated nature."‖ It would, however, seem that Sir H. either wrote his lectures in the winter, or neglected to examine what occurred among them in his garden after night. If this had been done, he would have found, that leaves generally have the same power "to elevate themselves on the footstalk" when midnight darkness prevails, and when subjected to the "defect of the action of heat, and excess of the operation of moisture," as they have when "the mechanical and chemical agency of light and heat" predominate. That is, if the same occurred in Sir H.'s garden as happens in mine, and as I believe takes place wherever vegetation exists. This seems to demonstrate, that nothing short of the powerful principle of life could keep the leaves elevated, when subjected to the action of powers diametrically opposite. In the day,

* See his Lec. on Agr. Chem. page 66. † Idem, page 65.
‡ Idem, page 65. § Idem, page 250. ‖ Idem, page 54.

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there is heat, and often want of moisture: at night there is the abstraction of the one and the application of the other.

This day, to wit, the 17th of July, the mercury in Fahrenheit's thermometer rose no higher in the shade than 79: still I observed, about eleven o'clock, that some thrifty cabbage plants growing in my garden, where the ground was rich, had drooped their leaves very considerably, although no lack of moisture prevailed. In the warmest part of the day they drooped still more, and became very flaccid. One plant especially was so much affected, that I doubted whether it might not be injured by cut-worms at the root. However, about an hour before sun down, I visited the plants again, and found the leaves in general had risen considerably. At sun down, most of them appeared as if nothing uncommon had happened. In about two hours after, I found even the plant that had been most affected, perfectly restored, and quite wet with dew.

Now it seems as evident as almost any other thing, that an excess of stimulus, or to use Sir H.'s own terms, (as words never did nor never can alter the nature of things,) "an excess of the mechanical and chemical agency of light and heat," caused indirect debility in the vegetable system, as often occurs in animal systems; and nature, like a skilful physician, who regardless of learned, but at the same time discordant and absurd theories, boldly reduces the temperature of the system, and the energetic principle of life no longer oppressed, enables the leaves to elevate themselves on the foot stalks; and not only braves midnight darkness, and "a defect of the action of heat, and an excess of the operation of moisture," but also profits exceedingly by this very salutary and interesting change; which contributes to establish a striking analogy between animals and plants.

The changes from excess of heat are still more frequent and manifest in the pompion than in the cabbage. During the heat of the day, when the weather is warm, the leaves collapse, and the flower folds itself up, and they remain in this situation until the evening, when the former becomes again expanded, and the latter unfolded.

Some flowers are so remarked for withdrawing from the heat of the sun, that the common names by which they are called are descriptive of this obvious property. The morning-glory* is found fully expanded in the morning, but closes as the heat of the day increases. The four-o'clock or pretty-by-night† closes when the heat of the sun becomes offensive to it, and expands toward evening when the rays of that luminary become milder. To enter into a tedious detail of the subject, would be foreign to my purpose. So far, however, as my observation extends, the leaves of many more plants are "closed or folded together" by an "excess of heat" than by "a defect of the action of heat, and an excess of the operation of moisture."

The organization of the leaves and flowers of plants seems to be

* A species of convolvulus. † Also called, marvel of Peru.

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the most perfect and delicate parts of their structure, and, of consequence, most readily affected by change. Therefore, an excess of heat appears to be more or less offensive to all plants. But that degree of heat which proves offensive or injurious to one plant, may be very refreshing and salutary to another; and the same may be said of "the operation of moisture."

Maize thrives most luxuriantly in our climate, when the weather is very warm, if a sufficiency of moisture also obtains. When moisture fails to any considerable extent, and the weather is very warm, the leaves of this hardy plant curl up in rolls through the heat of the day, and expand again in the evening when refreshed with the dew. They are employed through the night in collecting moisture, which they convey into the cells formed by that part of the leaf, which runs some distance up, and clasps the stalk, previously to its taking a slanting direction from it, which inclines upward. When these cells are filled with moisture, the overplus runs down the stalk, in a dry time, in such abundance, that the ground for two inches or more around the stalk, exhibits in the morning the appearance of an artificial watering. The leaves have been admirably formed to perform these interesting functions. In the morning, the plant seems to be as much refreshed as is a weary traveller, who, after being exhausted by performing a long journey on foot, has been well refreshed in the evening, and comfortably lodged through the night.

The traveller when exhausted by exercise and oppressed by heat, retires to rest in the shade, during the hottest part of the day. The corn plant cannot do this; but it escapes the too powerful action of radical heat on the upper surface of its leaves, by curling them up, when the sun becomes very offensive to them. This very interesting economy of nature checks evaporation; and sufficient rest is obtained to prevent any very serious injury, unless the drought should happen to continue uncommonly long. The water running down the stalks invigorates the roots, and the moisture stored up in the cells, is consumed by the plant. As the arm or stem on which the ears are formed, grow out from the joint of the stalk at the bottom of the cell, and the growth of the ear does not, when the plant is healthy, prevent the moisture from running into the cells, or cause it to leak out of them, we may clearly see that this moisture is highly important to the growth of the ear, and the maturity of the grain. For when too close planting, or any other cause debilitates the corn plant, we often see, after the point of the ear has grown out at the mouth of the receptacle or cell, that its vegetative powers are too weak to press out the larger parts of it. In this case, it grows feebly within the cell; and closes the mouth of it; and splits that part of the leaf which forms it, and also binds the arm on which the ear grows to the stalk. Consequently, but little if any moisture can either enter or be retained in the receptacle, and the product, under the most favourable circumstances, is a nubbin, and often of so little value, that it is not worth gathering.

In some few instances, we also observe that, in consequence of

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debility, that part of the leaf which forms the cell, and bends the arm on which the ear grows fast to the stalk, has not power to cling closely to it. In this case, the mouth of the cell becomes unusually wide; the whole of it more or less leaky; and the greater part, at least, of the moisture is lost. The effect of this is also a nubbin, and often not worth gathering.

Practice clearly determines that this moisture actually exists in the cells; for it has been the too general custom to pull off the abortive ear shoots, or suckers as they are commonly called, growing at least at one joint of the stalk above that in contact with the ground. When this is done, the economy of the cells is very much injured, and we see the water running out of them in streams, even until it reaches the ground; unless a succession of dewless nights have occurred previously to this operation. In that case no water follows the pulling off of the suckers, and the corn plant of course suffers much more from drought. But as a very long succession of dewless nights seldom occurs, this plant is as little or perhaps less injured by drought, than any of the corn plants cultivated by us.

There is a multitude of annual plants whose leaves clasp their stalks as do the leaves of the corn plant; and no question but they also derive much advantage from this simple arrangement. But as maize is large the economy of it is more readily seen. However, as the leaves of a multitude of plants which are very differently constructed, do not "close or fold together" through the day or night, no question but there is quite as good reasons why they should continue open, as there is for the corn plant to maintain or assume that posture; although the advantages they may derive from maintaining a uniform position are not so readily seen.

Sir Humphrey informs us, "The ammonia given off from animal compounds in putrefaction may be conceived to be formed at the time of their decomposition;" and that "except this matter, the other products of putrefaction are analogous to those afforded by the fermentation of vegetable substances."* The products of the decomposition of vegetable substances have been enumerated and described by this gentleman and others. They are highly interesting, in powerfully establishing the very great analogy between animals and plants; but are still vastly more so in the proper use of them so far as agriculture is concerned; and this is best ordered by harmonizing nature and reason in the application and management of them.

Sir H. also tells us, "The pistil is the organ which contains the rudiments of the seed; but the seed is never formed as a reproductive germ; without the influence of the pollen, or dust on the anthers."

"This mysterious impression is necessary to the continued succession of the different vegetable tribes. It is a feature which extends the resemblances of the different orders of beings, and es-

* See his Lec. on Agr. Chem. pages 277 and 278.

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tablishes, on a great scale, the beautiful analogy of nature."* Also, that "Linnæus has the glory of establishing the sexual system, upon the basis of minute observations and accurate experiments."†

This is certainly "establishing the resemblances of the different orders of beings on a great scale," but no greater than true. The result of the sexual union between the male and female organs of plants, and that of animals is, in either case, life: common physical agents are in both instances employed, or made subservient to the propagation and preservation of this invisible but exceedingly powerful principle.

No combination of common physical agents can *ever* organize dead matter so as to fit it to perform the functions of life: consequently, this and the superior powers of action or animation can proceed from no less a cause than life itself. Not that life which is set, and kept in motion by common physical causes, as is the fermenting liquor in a brewer's vat.

However, notwithstanding these obvious facts, and what I have just now quoted from Sir H.'s lectures, he tells us, that "In calling forth the vegetable functions, common physical agents alone seem to operate;" and that "nothing above common matter exists in the vegetable economy."

This gentleman says "The pores in the fibres of the roots of plants are so small, that it is with difficulty they can be discovered by the microscope; it is not, therefore, probable, that solid substances can pass into them from the soil. I tried an experiment on this subject; some impalpable powdered charcoal was placed in a phial containing pure water, in which a plant of peppermint was growing, the roots of the plant were pretty generally in contact with the coal. The growth of the plant was very vigorous during a fortnight, when it was taken out of the phial: the roots were cut through in different parts; but no carbonaceous matter could be discovered in them, nor were the smallest fibres blackened by the charcoal, though this must have been the case had the charcoal been absorbed in a solid form. No substance is more necessary to plants than carbonaceous matter;‡ and if this cannot be introduced into the organs of plants except in a state of solution, there is every reason to suppose that other substances less essential will be in the same case."§

The bark of the smaller roots seems to have been formed to expand and contract much more readily, than that of the branches and twigs of the same size. The bark of the latter is not commonly so soft, whether it be rough or smooth; neither is it any thing like so elastic.

* See his Lec. on Agr. Chem. page 69. † Idem, page 70.

‡ This experiment alone should have taught Sir H. that he was egregiously mistaken in supposing, that no substance "is more necessary to plants than carbonaceous matter;" especially charcoal when fully formed, and of consequence stripped of nearly all the decomposable animal and vegetable matters, which alone furnish food for either plants or animals

§ See his Lec. on Agr. Chem. pages 269 and 270.

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The wood of the smaller roots is also generally much more flexible than that of the branches and twigs of the same size. In fact, the construction of the smaller roots and fibres seems well calculated to contract and expand. Therefore the pores in them may be much more considerably expanded by the principle of life, stimulated into action by the natural wants and appetite of the plant, than Sir H. (who relies on common physical agents) seems to imagine: especially as the organization of them does not seem to be understood, and may, like that of certain parts of some animals, be calculated to expand and contract considerably, in proportion to the size of the fibres or root. There is a wide difference between the size of the common snakes which inhabit our fields and that of a very large ox; still we find that the former swallow animals whole and entire which measures more round their bodies than do their own; and that the ox is often choked and sometimes killed, by attempting to swallow much less substances, when hunger urges him to eat too greedily.

The economy of the snake should also teach us, that the organs of plants, as well as the organs of animals, act in perfect unison. As unerring wisdom has ordered this animal to swallow its food without mastication, its digestive organs are so amazingly powerful, that the teeth of squirrels (than which not many things in nature are harder) are found, after the snake has been killed and opened, so very soft, that there seems to be every reason to believe, that the teeth as well as the bones of the animals swallowed by him, are eventually as well digested as is the flesh of them.

The small size of the pores in the roots and fibres of plants, seems to be a very wise provision of nature. As they were formed to live within the earth, if the pores had been made large, they would not have been so well calculated to gather nutriment, without taking up with it more earthy matters than could be well applied in forming the structure of the plants. It would also appear, that the provision which has been made for animals to get rid of solid excrementitious matters does not exist in the structure of plants: therefore it became proper that the organization of the mouths and tubes by which this nutriment was gathered and conducted into their system, should be small.

It is also worthy of remark, that charcoal, when reduced to an impalpable powder, seems to be a less difficult substance to be taken up by the pores in the roots of plants, and conveyed by them, than is the earth, which is, after it has been reduced to the same state, (either by natural causes or cultivation,) much heavier than the coal; still no traces of the charcoal could be discovered in the mint plant by Sir H. From this it would appear that, however useful pure carbon may be in forming the structure of plants, that when this substance is incorporated with undecomposed (highly scorched) vegetable matter or coal, it is rejected by plants; at least so far as the organization of their roots will permit this to be done. Also that the power to reject injurious matters in a solid form is

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much greater than when presented in solution; for even poisonous substances, when dissolved in water, are so freely taken up by the thirsty plant confined in them that death speedily ensues. In fact, it would appear that plants have no more power to separate and reject injurious substances held in solution by water, than have animals; and that thirst urges both to drink, be the consequence what it may when no other water can be had.

It is probable, that in common, but little unfermented animal and vegetable matter is taken up by plants, as the materials which furnish it are generally in a state of fermentation and decomposition; but when copious and long continued rains occur, and fermentation and decomposition are greatly retarded in consequence of too little heat to favour the process, it would seem that animal and vegetable matter is conveyed by water through the soil in simple solution, and that plants cannot select putrescent matters so effectually, as not to be compelled to take up matters that have not been fermented. For we see when much rain has fallen, and the weather is too cool to favour fermentation, vegetation progresses languidly, and many plants turn sallow, and look very feeble and sickly. That plants do drink water in which unfermented vegetable matter has been infused, is seen by their being tinged red, when placed in infusions of madder previously to the fermentation of the liquid.

If Sir H.'s discordant system had not compelled him to contradict himself so often, it would really seem strange, that he should tell us, "The pores in the roots of plants, are so small, it is probable that the solid substances cannot pass into them from the soil." He elsewhere says "The earths found in plants are four;"* also, that "they differ in the same species of vegetation when it is raised on different soils;"† likewise, that "plants growing on a soil incapable of supplying them with sufficient manure, or dead organized matter, are in general very low, and their woody fibre abounds in earth."‡ This shows that the earth found in plants is furnished by the soil in which the plants grow; and common sense dictates, that they could not find their way into the plants, by any other passage but through the pores in their roots.

Surely this gentleman must have forgotten that he had told us "Gypsum is not taken up in corn crops, or crops of peas and beans; but where lands are exclusively devoted to pasturage and hay it is continually consumed."§

* See his Lec. on Agr. Chem. page 113.
† Idem, page 126.
‡ Idem, page 263.
§ Idem, page 333.

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CHAPTER VI.

The heart-wood of a tree proved to be alive, and increasing annually in size. It is also shown, that the pores in the wood appear to be well constructed to admit a lateral circulation from the alburnum to the pith. Linnæus's and Dr. Hales's theories of the pith considered. The changes in timber explained.

Sir H. Davy says, "The wood of trees is composed of an external or *living* part, called the alburnum, or sap-wood, and an internal or *dead* part, the heart-wood."*

Dr. Darwin informs us, "When old oaks, or willows, lose by decay almost all their solid internal wood, it frequently happens, that a part of the shell of the stem continues to flourish with a few healthy branches. Whence it appears, that no part of the tree is alive but the buds, and the bark, and the root fibres; that the bark is only an intertexture of the caudexes of the numerous buds, as they pass down to shoot their radicals into the earth; and that the solid timber of a tree ceases to be alive; and is then only of service to support a numerous family of buds in the air.

"A bud of a tree, therefore, like a vegetable arising from a seed, consists of three parts; the plumula or leaf, the radical or root-fibres, and the part which joins these together, which is called by Linnæus the caudex, when applied to entire plants; and may, therefore, be termed caudex gemmæ when applied to buds."†

"As the spring advances, the umbilical vessels, after having drunk up the reservoirs of nutriment, which were deposited about the roots, and having thus nourished and expanded the new leaves, cease to act; and the alburnum gradually changes into hard wood, called the heart of the tree: which no longer possesses vegetable life; and is now only useful to elevate and sustain aloft the swarm of biennial plants, which cover it."‡ "But the umbilical vessels of the alburnum, possess the properties of capillary tubes, or of a sponge after they are *extinct*, and cease to act as umbilical vessels; and thus they occasionally attract moisture or suffer it to pass through them mechanically."§ "The existence of capillary tubes in dead sap-wood is visible in a piece of dry cane, which permits water or smoke to pass through it; and in the exhausted receiver of an air-pump both water and quicksilver may be made readily to pass through pieces of the dry alburnum of wood by the pressure of the atmosphere."‖

* See his Lec. on Agr. Chem. page 60.
† See his Phytol. pages 2 and 3.
‡ Idem, page 162. § Idem, page 162.
‖ Idem, pages 163, and 164.

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"The buds producing flowers are each an individual *being* as well as the leaf buds above described, though they are probably not so easily capable of transplantation into the bark of other trees by inoculation."*

"The caudex of perennial herbaceous plants consists of a broad plate, buried beneath the soil to protect them from frost; while the caudex of buds of trees consist of a long vascular cord, extending from the bud on the branch to the radical beneath the earth, and endures the winter frost without injury."†

To a plain practical farmer in the back-woods who sees nature as she is, and who has not science to depend upon, nor is infatuated with the wild irrational theories which have been too hastily built on it, but endeavours to make nature, reason, common sense, and observation alone his guides, nothing can be more preposterous than the idea, that "no part of a tree is alive but the buds and the bark, and the root fibres; and that the solid timber ceases to be alive; and is only of service to support a numerous family of buds in the air; or as the Doctor says, in another part of his book, "is now only useful to elevate and sustain aloft the swarm of biennial plants which cover it."

However, the Doctor seems to have endeavoured to form a theory consistent in all its parts, as he tells us, "the buds producing flowers are each an individual *being*, as well as the leaf buds;" and that this individual bud or *being*, as well as the leaf bud or *being*, is so completely separated from the parent tree, that "the caudex of buds of trees consists of a long vascular cord, extending from the bud on the branch to the radical beneath the earth."

The Doctor does not tell us by what method he was enabled to trace the very long "vascular cord," from the most remote "radical," to the "individual *being*" or "bud" to which it belonged, growing on the uppermost branch of the parent tree; although it seems to have required great skill and ingenuity to perform this extensive, and seemingly very complicated operation. The vascular cords must be very numerous, especially in the elm; for if Dr. Willich be right, in what he says has been established by practice in forming of hedges, it would appear, that a great number of vascular cords extended not only from the radical to the bud, but also from the radical to the germinating eyes, or "individual beings," existing in the body of the parent tree, which must form a very complex system of "vascular cords," or cords upon cords, so intimately blended or intermixed, that it would be exceedingly difficult even for a philosopher to trace any one of them. This gentleman informs us, "when elm-timber is felled in the spring, the chips made in trimming the trees are to be sown, and harrowed in, as practised with corn. Every chip that has an eye or bud, will speedily shoot like the cuttings of potatoes; they pos-

* See his Phytol. page 5. † Idem, page 4.

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sess this farther advantage, that five or six stems will generally rise from the same chip; and, after being cut down to within three inches of the ground they multiply their side shoots and form a thicker hedge, than any other method hitherto practiced."* Now it is evident, that such a multitude of eyes or "beings" will require a multitude of "vascular cords."

Whether the word "trimming" means hewing the timber, or chopping off and cutting up the limbs, or both, is unknown to me. But if the chips obtained by either of those means, grow in sufficient numbers to make it an object to sow them, it would seem that the organization or eye formed in the solid wood of the tree germinates; of consequence that the wood is not dead.

However, of this I know nothing, either by practice or observation. But it is well known where I now reside, that the red elm (as it is called here) is readily killed by girdling. Also, that it is otherwise with what is called the white elm. This last, with the sugar tree, some other maples, and several other kinds of trees, after being girdled as deep as it may be done, without running a great risk of their breaking off where the girdle is formed, sometimes live for years after this operation. It has therefore become a common practice, in place of girdling trees of this description, to pile heaps of brush and other wood around them, and destroy their vegetative powers by burning. Still it often happens that, notwithstanding the bark has been burnt off as high up as the intense heat of the fire extends, and the sap-wood severely scorched or corroded, that the trees live long enough to be very injurious to the farmer's crops. It therefore appears that even fire does not effectually kill trees of this description, unless the degree of heat applied be sufficient to destroy the interior organization of them.

Trees of this kind will often put out leaves, year after year, until the water which runs down the body of the tree, and settles where it has been girdled, causes the wood at this place to decay, and the body of the tree to break off at that point, and fall to the ground.

Long practice has taught the back woods farmer, that notwithstanding some kinds of trees linger long after being girdled, all of them eventually die, provided the girdle be carefully cut through the sap into the heart-wood of the tree. The oak, pine, hickory, chesnut, and many other trees, are readily killed by girdling; but some of these kinds linger longer than others. From which it clearly appears, that the sap-wood, bark, and leaves are the great vascular system in which the nutritious matters gathered by the roots, and most probably by the leaves, and absorbent vessels in the bark also, circulate, until it is properly prepared; and that after this, it is from thence diffused, and effectually applied, not only to the exterior growth of the tree, its seeds, &c. but also to the interior growth of it. This will, I trust, be made manifest, notwithstanding we have been assured that the heart-wood of a tree is dead.

* See Domes. Encyc. art. Elm.

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As some trees linger long after they have been effectually girdled, it would seem that the little circulation of the fluids between the roots, and the buds which in this case takes place, must pass through the heart-wood at that part of the body where the girdle is formed. The blowing through a cooper's stave, made of well seasoned heart-wood, determines that the pores continue open in the solid heart-wood of the tree.

The result of girdling, however, proves that after the great avenue for the circulation of the sap has been cut off by this operation, death always sooner or later ensues. Yet I would advise those who are fond of making experiments on interesting subjects, to try whether covering the girdled part so soon as the girdle is formed, with a proper mollifying plaster, well calculated to exclude the air, would not restore the tree; as in cases of great injury, such plasters have produced surprising effects.

Dr. Darwin attributed the general circulation of the sap "to the living powers of the plant, and stimulus of air upon the leaves, and moisture upon the roots."* However, as he considered "no part of a tree alive but the buds, and bark, and the root fibres," this error led him to refer the circulation of the fluids between the living and what he calls the dead part of the tree, to common physical agents.

He tells us, "the umbilical vessels of the alburnum possess the properties of capillary tubes, or of a sponge after they are extinct, and cease to act as umbilical vessels; and thus they occasionally attract moisture, or suffer it to pass through them mechanically; whilst the new bark which consists of an intertexture of the caudexes of each bud with their radicals, may occasionally absorb this moisture from the capillary vessels of the alburnum, which may be compared to the upper stratum of the soil attracting by capillary power the moisture from the ground immediately underneath it, which may exhale into the atmosphere, or be imbibed by the roots of vegetables by the superior living power of their absorbent mouths."† In the following page, the Doctor tells us, "that the vessels of the alburnum, after their vegetable life is extinct, possess a power of capillary attraction of the *sap-juice*, or permitting it to pass through them occasionally."

Now I must confess that the advantages which may be derived, from the circulation of the *sap-juice*, between the living and dead parts of a tree, is beyond my comprehension; although I can readily see, (and I trust demonstrate,) that important advantages are derived from that circulation of nutritious matters,‡ which the result proves are actually conveyed from the great vascular system of a tree, to the most interior parts of it.

The girdled timber is often used in the back woods for building,

* See Sir H. Davy's Lec. on Agr. Chem. page 33.

† See his Phytol. page 162.

‡ No question but the matters calculated to form the increased structure of the interior parts of the tree, are also conveyed in the same way.

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fencing, firewood, &c. It becomes so hard that our wood choppers say, it requires as much labour to cut and split two cords of dead oak as three cords of the same kind of wood when it is green. The workers in wood do not find the girdled timber any thing like so tough or flexible as green wood. It splits much freer in consequence of the grain being very brittle. When split, however, the grain, in place of exhibiting that lively appearance seen in green wood, looks dead and is often marked with spots denoting approaching decay. These spots seem to proceed from the timber being so large that the sap cannot evaporate freely from the interior parts of the tree. If timber be placed in those parts of a building from which the air is much excluded, before it has been properly seasoned, the dry rot quickly ensues. Mr. Bordley tells us, "a pair of cart wheels, as soon as made, were tarred over thickly, and set up, resting on the side of a house a year or two. When put to use the felloes broke and showed a sound surface, and the rest a dark,* rotten coarse powder. Here the *unseasoned* wood being coated over so as to obstruct the sap from evaporating, the sap fermented, it is presumed, and rotted the inside of the solid parts of the timber: the shell or outside of the timber having been seasoned or lost its sap, before the tar was applied. In forests, I have stepped on the bodies of prostrate trees, which appeared sound to the eye: but have broke through the seasoned crust to a mass of rotten powder."†

A few weeks since, an oak was chopped down near this place, to make the hammer shaft of a forge. It is said the growths were counted, and that the tree was more than five hundred years old, although much less than many other oaks growing in that neighbourhood. Now, it would appear that a part of the heart-wood of this tree, must have existed about five hundred years ago; and that this heart-wood has been, (if Sir H. Davy's, and Dr. Drawin's theories be correct,) dead, and entombed, during about five centuries, and other dead wood annually added to it: and if what we are told of the great age of some trees be true, those additions might have been annually continued for five hundred years yet to come, if the tree had not been cut down.

We all see that after the living principle becomes extinct in the animal or vegetable system, that system either sooner or later sinks into decay. The bones of animals are the hardest parts of them, and it is long before the solid parts of them crumble to pieces; but the "decomposable animal matter"‡ contained in them runs quickly into decay.

The woody fibre is the most solid part of a tree, especially the heart-wood: consequently, it is slowly decomposed, unless it be

* When trees lie in our forests until decomposed, as far as was Mr. Bordley's cart wheels, the powder produced by decomposition, is of a redish colour, not so dark as Spanish brown, nor so bright as red ochre.

† See his work on Husb. pages 459 and 460.

‡ See Sir H. Davy's Lec. on Agr. Chem. page 290.

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placed in a situation which greatly favours this process. There are, however, a variety of vegetable matters intimately blended with the woody fibre, which are vastly more readily decomposed than it. The hasty decomposition which took place, in the heart-wood of which Mr. Bordley's cart wheels were made, clearly determines, that these matters powerfully assist, and greatly hasten, the decomposition of the woody fibre with which they are always intimately mixed.

That the sap continues to exist in the heart-wood of a tree, as long as the tree is alive, is well known to all the workers in wood in the back-woods: as is also the means to get speedily rid of it. Various causes seem to compel them to do their work with wood that has recently been cut down.

The mill-wright selects the cogs for his wheels, from the heart of the hardest wood. Notwithstanding the pores of the wood are close, and its texture very firm, experience has taught him, that unless the sap be extracted, his work will not stand. He therefore shapes out his cogs, puts them into a large kettle, and boils them in water, until the sap is thoroughly extracted. As the water evaporates quickly after the cogs have been spread out to dry, the process is very quick.

The larger timber that must be seasoned previously to its being used, is by some put into a pond or run of water, and after the sap has been extracted, it is dried. By others, it is placed in that way which is best calculated to keep a fire constantly burning underneath it. This causes the watery particles of the sap speedily to evaporate, and the more solid matters of it to inspissate and become hard by sudden heat, so as nearly to fill up the pores, which have been greatly compressed, by the shrinking of the woody fibre. The sap thus cured is prevented from fermenting and rotting the wood, and also from evaporating. Wood seasoned in this last way, is less liable to imbibe moisture, and swell, or shrink by parting with it, than is wood seasoned by boiling, soaking, or exposing it to the atmospheric air, rain, &c. The pores of the wood are not near so well closed by the three last mentioned processes as they are by the timber being dried in a kiln.

It is impossible to believe, that the workers in wood could have been so stupid, as to perpetuate, from time immemorial, the very laborious practice of extracting, expelling, or consolidating the sap in the heart-wood, not only of young timber, but also of that obtained from a tree of five hundred years old, if the sap did not exist in sufficient quantities to greatly injure the durability of the timber, as well as the durability and usefulness of the articles formed of it.

Now as practice clearly determines that the sap exists in the heart-wood of old as well as in that of young trees, how does it happen, if this wood be dead, that fermentation does not destroy it, as it did the same description of wood in Mr. Bordley's cart wheels? Those who are not conversant with trees, may urge that in the case of Mr. Bordley's wheels, a sufficiency of air was admitted to favour

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the process of fermentation; but that the alburnum and bark which closely envelope the heart-wood in a tree, may exclude the atmospheric air so effectually, that fermentation cannot take place. Some accidental causes expose the heart-wood of trees so much to the injurious effects of moisture and air, that it sinks into decay. There are, however, less powerful causes which would produce the same injurious effects if it were not alive. The wind-shakes, as they are commonly called, seem to be exactly calculated to effect the destruction of the heart-wood if it were a dead substance. These commonly commence near the but, and often run eight or ten feet up the body of the tree. The split frequently extends from the outside surface to the middle of the heart-wood. They seldom if ever close, being, as it is supposed, kept open by the agitation occasioned by the action of the wind on the top of the tree. They rarely become wide, but are sufficiently extended to determine, that air passes through them, in sufficient quantities to favour the fermentation of the woody fibre if it were dead; for both sides of the rent become much darker coloured than the fresh wood of the tree. However, a tree thus affected, seems to grow as well, and continues as free from decay as any other. Whether the name of these rents is descriptive of the cause that forms them, is unknown to me; but many of the trees growing in our forests are wind-shaken. It is thought by numbers here, that intense frost splits the trees, and that the rents are kept open by the action of the wind on the top of them. When the nights are intensely cold and calm, we often hear a loud cracking noise in various directions through the forest. It is then said by my neighbours that the frost is splitting the trees. Be this however as it may, the trees are split in the way that has been described; and these rents continue open, without any apparent injury, either to the growth or health of them.

Trees do not split any thing like so freely in any other direction, as from the circumference to the centre. When shingles, pailing, lath, &c. are to be made, the tree is first quartered, and the quarters after this split into bolts of a proper size; always taking care to split them in the same direction as the quarters were split. The shingles, &c. are also split in the same way.

Now as this mode of splitting, immediately crosses the grain which denotes the age of the tree, the ready splitting of the wood in this direction seems to determine, that the powerful principle of life acting in a favourable temperature, may also readily expand the woody fibre, so as to admit the lateral circulation of the sap, from the alburnum or bark to the pith of the tree. This seems to be confirmed by what takes place in the ends of the logs with which our houses or cabins are built. In hewing the two sides of them, the pith is commonly left in or near the centre of the log. The action of the sun and air on the ends of the logs, causes the grain of the wood to separate, and we observe, that the largest cracks or openings which are made by the agents, run from the pith toward that part where the circumferences of the tree existed before the tim-

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ber had been hewn. But as we also see that the grain of the wood is minutely separated by smaller cracks or openings, throughout the whole of the end of the log, there seems to be every reason to believe, that the sap circulates through the whole of the woody fibre in a tree. This appears to be confirmed, as the same is seen in the ends of our fence rails, after being some time exposed to the influence of the sun and air; and the result in a living tree demonstrates that these conclusions are just.

Having attentively observed that the annual growths of the heart-wood of trees, were much closed together as they approached nearer towards the alburnum, and that in young trees after the heart-wood had been distinctly formed, the annual growths from the pith to the circumference, were *vastly* closer together than the same growths in older trees: also, that the annual growths in the heart-wood of these younger as well as older trees, were not near so wide apart as they approach towards the alburnum, as they were nearer to the pith, I was led to believe that the theories founded on the heart-wood of a tree being dead, might be readily proved erroneous; by means so obvious and simple, that every person living where he could see timber of different ages cut down, would be convinced by occular demonstration, that the heart-wood of a healthy tree is so far from being dead, that it grows annually, until the tree attains its full age. After which, trees, as well as animals, sooner or later decline; and however long either may linger, death evidently closes the scene.

To substantiate this fact so that it might be understood, it was considered necessary to select trees of different sizes, but of the same kind of wood, and grown on a similar soil, and to measure the diameter of each clear of the bark. Also, to count the annual growths of each of them. The diameter of three white pine trees, which had been recently cut down, was measured, and the annual growths of each of them carefully counted. The wood of the smallest tree measured six inches and three quarters across the but-end of it; the annual growths were very close together, and counted one hundred and twenty-seven. The next larger tree measured thirteen inches; the annual growths in it were considerably wider apart than in the first mentioned tree, as the reader will very readily imagine when he is told they counted only one hundred and sixty, and considers the great difference in the diameters of the trees. The next and largest tree measured two feet, ten inches and three quarters across the but of it. In this tree the annual growths were vastly wider apart than in the second tree, which is also very readily imagined as the diameter of it more than doubled that of the other, and the annual growths counted only one hundred and seventy-five.

In trees of the same kind, measuring about four feet in diameter across the but, the annual growths are still much wider apart than in trees of the last mentioned size, but as none of this size has been lately cut down here, the growths have been so much defaced by time, and the turpentine running out from the pores, that they could

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not be counted with sufficient correctness to form an exact estimate of them.

To comment on facts so obvious, would be useless, especially as every person who resides near to where timber is cut down, has it in his power to examine these facts for himself; and no question after he has satisfied himself on this very interesting subject, but he will agree with me, that if the heart-wood of a tree were dead, it could not increase so very much in size, in the course of fifteen years, as it certainly did in the largest of the three pines mentioned above: particularly the annual growths, as they approach near to the alburnum, are often but little more than lines.* Sir H. Davy says, that Linnæus conceived the pith performed for the plant the same functions as the brain and nerves in animated beings. He considered it as the organ of irritability, and the seat of life. "The latest discoveries have proved, that these two opinions are equally erroneous. Mr. Knight has removed the pith in several young trees, and they continue to live and increase. It is evidently then only an organ of secondary importance."†

Sir H. must mean, that Mr. Knight "removed the pith in the *trunks* of several young trees;" and perhaps from some of the larger branches also. If he had removed it from the roots and radical fibres, and likewise from the smaller branches, twigs, and buds, the plants would have been so mangled that they could not live.

This being the case, Sir H. should have recollected, that plants are much more tenacious of life than are animals. As Mr. Knight's operations did not so materially injure the great vascular system through which the sap more especially passes, the pith remaining in the roots, radical fibres, small branches, twigs, and buds, might have been fully sufficient to perform the important function which Linnæus assigns to it. Particularly as we see, without the aid of experiment, that both large and small trees do perform these functions, after causes (which do not seem to be correctly or fully understood,) have removed, by decay, much more of the pith from the trunks, roots and branches of them, than Mr. Knight could possibly have done *safely* even if that part of a tree be of no more consequence in the economy of it than any other part: consequently, Mr. Knight's experiments have not proved that Linnæus's "opinions are erroneous," or that the powers ascribed by Dr. Hales to the pith, are visionary. In fact, these experiments prove nothing more than every man who has been conversant with trees, has known from time immemorial. It is, however, very observable, that gentlemen intent on becoming scientifically acquainted with nature, are too often so regardless of her simple and very obvious economy, that they make elaborate experiments to ascertain facts, which are well known to every person who is practically conversant with the subject they

* The annual growths, as they are usually called, increased in width in the heart-wood, in due proportion to the increased size of the trees.

† See his Lec. on Agr. Chem. page 62.

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wish to elucidate. And after these gentlemen have discovered what they wish to know, (or, as was the case with Mr. Knight, merely imagine this has been done,) they very often too hastily form erroneous systems, either on real facts, or on such facts as are only supposed to exist. As much attention, investigation, and talent, are frequently displayed, not only in the progress of these experiments, but also in a multitude of other things, the reputation of the philosopher appears to stamp even his errors with the broad seal of intrinsic value: consequently these errors are but too frequently adopted by other gentlemen of distinguished talents, without being first investigated by them. Hence it is, that we have so long and often been told, by different gentlemen, that the heart-wood of a tree is dead, and that nothing above common matter exists in the vegetable economy. But to return.

"Dr. Darwin, when speaking of a bud, observes, "It consists, first, of a central organization, or caudex, like the corculum of a seed, which contains the rudiments of arteries, veins, absorbent vessels, and glands, with an internal pith or brain."

I have already mentioned the importance which Dr. Hales and Linnæus attach to the pith. Although neither of these gentlemen's opinions have, and perhaps never may be, confirmed exactly as they have stated them, it would appear they had very good reasons to induce them to believe, that the pith, if not the seat of life, is highly important to the preservation of it. We may observe, that even where the pith is most exposed to the severities of the winter, it wonderfully shields or defends the principle of life; as notwithstanding the frosts sometimes greatly injure the small branches, twigs, and buds of trees, the principle of life seems generally to remain unhurt in them, although it is defended from the inclemency of the weather, by a very slender covering. In place of being injured by this seemingly very severe exposure, it appears that so soon as the temperature, either in the latter part of the winter, or in the spring, favours the action of the powerful principle of life, in the small branches, twigs, and buds, it acts with all that increased energy which is the natural consequence of rest; and that as the change in the temperature is not so soon felt in the interior parts of the tree, the springs of vegetation are first set in motion, where the inclemency of the weather has been most severe. For we may observe that the uppermost buds on trees swell in size, and put out into leaf, sooner than the buds beneath them.

I have seen plants of maize growing on poor ground, and of consequence debilitated, entirely destroyed by the same frost, that did but little comparative injury to strong and vigorous plants of the same description, growing near to them, but on a rich soil. Wheat growing on a thin soil is often destroyed by frost, through the winter, while that growing near to it, but where the ground is rich, escaped injury.

The vigour of plants, or *life*, like that of animals, seems to depend upon the quantity of nourishment, and the health of the parts des-

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tined to preserve it from the contingencies of the system. But to say precisely what life is, or where it absolutely resides, is perhaps impossible. Experience proves, that in the animal system some parts are more essential to the continuance of life than others, and why may not this be the case with vegetables? And until it be proved that the seat of life in them is not in the pith, it may be as well to believe that it resides there, as in any other part of their organization.

I will now transcribe what was published by me in 1816, in Mr. Poulsons's paper, on the changes in timber; and make some further remarks on that subject.

Mr. Poulson. The change in timber which takes place in our forests, has been the cause of controversy, which seems to have ended without satisfactory information. Judge Peters says, "I am charged by the *review maker*, with impiety and unphilosophical absurdity, and sentiments which I never held, to wit, that new and spontaneous productions are brought into existence by a new order of things."*

I shall not be umpire between the Judge and the British Reviewers. What he has written and sanctioned on the subject, ought to determine the question.† My residence, however, in the back-woods, induces me to think, the changes in timber, &c. may be very readily explained on simple and rational principles. Consequently, such as do not militate against either revelation, philosophy, or common sense.

The changes in timber and plants have been generally well described in the first volume of the Memoirs of the Philadelphia Agricultural Society; but the causes which produce this effect have been misunderstood.

The wisdom of the great Creator is wonderfully displayed in the formation of seeds. The tender texture of them is, for the most part, as capable of withstanding the destroying hand of time, as if they were formed of the most durable substances: provided they be permitted to remain where nature scatters them. This is best seen in the back-woods, where the rude hand of man has not marred the face of nature. Still we might have seen in our older settlements, that the seeds of the grasses, (on which the support of innumerable animals, great and small, principally depends,) have been so constructed that art cannot annihilate them, so far as to prevent nature, when the grounds are left to be managed by her, from spreading this necessary provision over the soil: and also to effect proper changes of vegetation even there. After a bad system of husbandry has impoverished the ground so much that even the seed of white clover (which will grow in a very thin soil) can no longer vegetate, if gypsum be applied, the ground is quickly covered with that grass.

* See Mem. Philad. Agr. Soc. vol. ii. page 360.

† See vol. i. of the same work, for what Mr. Peters has said on this subject; and also Dr. C. Caldwell's letter to him, which was published in the same book.

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If enriching manure be spread over the clover, it is soon rooted out by green grass, sometimes called blue grass. It is also a hardy native: but as this plant cannot find sufficient nutriment in a thin soil, the seed remains dormant until the ground be enriched.

But to return to the forest. Some seeds are calculated to be wafted far by the wind. Water sweeps off and carries many of them to distant shores. Numbers are also scattered widely by birds and quadrupeds. Still the effects produced by these causes are partial, and very trivial. The changes are principally effected by the seeds of scattering plants, that are *always* seen growing in greater or smaller numbers, among the plants that may happen very generally to prevail on the soil where the change is produced: or from seeds of other plants which had not, for a long time before, appeared on the soil, and which had been so deeply buried, by a long continued fall of the foliage, as well as the branches and bodies of the plants, which had grown there, that they could not vegetate, until the thickness of this covering had been reduced by burning of the woods, or the cultivation of the soil.

Burning quickly reduces the covering. As the Indian, as well as the white hunter, selects a dry time for setting fire to the woods, the timber is also very often destroyed, together with all the seed, within the reach of this destructive element. The sun being freely admitted, the seed, which had been deeply buried for ages, vegetates and comes up. The plants that in this case appear, are, for the most part, different from those that were destroyed by the burning, and from the prevailing timber in the neighbourhood.

When the new crop happens to be one of the very durable woods, we have sometimes direct testimony that similar timber to the young plants had existed there; as the remains of the same kind of wood are frequently found among the fallen timber.

Hence it is that in clearing of land in this neighbourhood, where white and spruce pines are generally the prevailing timber, locust quickly springs up in abundance where the log heaps were burned, but no where else in the clearing. The intense heat occasioned by the burning of so large a body of combustible matter, within so small a space, seldom fails to reduce the covering sufficiently to admit the seed to vegetate. The remains of the fallen locust clearly prove that this kind of timber formerly prevailed, or was at least much more plentiful than it is to be found at the present time. As the locust seems to be nearly as durable as red cedar, much time had elapsed since it prevailed. Yellow pine either preceded or followed it, for notwithstanding very few of these trees now appear, the farmers here gather their knots plentifully, as a substitute for candles, and also for making tar, where no other traces of the fallen timber appear. These knots seem to be nearly indestructible, for they are often ploughed out of the ground, without the least appearance of decay upon them.

It is a notorious fact that forest trees different from any that have been remembered to grow in the neighbourhood, have taken pos-

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session of old fields; the cultivation of which, appears to have forwarded the process: first, by promoting the gradual decomposition of the vegetable substances, of which a soil, when recently cleared from its wood, is principally composed: for although this covering is thick, if the soil be deep, it becomes very thin, after the vegetable matter is reduced to apparent earth. Secondly, the regular cultivation destroys the seed above those that lay deeply buried. Thirdly, the furrows made by the plough in the last cultivation, uncovered and brought up the seeds that had lain buried beyond the power of vegetation for ages unhurt. It is, therefore, by no means wonderful, that the plants grown from these seeds should be very different from the prevailing timber in the neighbourhood.

In the cases mentioned above, it clearly appears that provision has been made to enable nature to resume her violated domain, long after art had apparently destroyed every vestige of the forest glade, or prairy, which had been for ages left to be managed by her, and that this is effected by seed.

When the timber in our forests is destroyed by age, tornadoes, or in any other way that has claimed my attention, except those which have been mentioned above, a growth of plants different from the prevailing timber commonly takes place. As in this case, the covering over the seeds, which had been long buried beyond the power of vegetation, can be but little reduced by the decomposition of it, before a new growth of plants takes place, from a stratum of seeds lying nearer to the surface, the young plants and trees are gene rally composed of such kind of timber, as was at the time the destruction took place, thinly scattered in greater or smaller numbers, among the timber that generally prevailed.

This determines that nature sets the example of change. But mark: as she is principally indebted for the means by which it is effected to the seeds grown on the soil where the change is produced, the changes made by her are immediately opposed to the very injurious change in the "locality" of seeds, which Mr. Peters endeavours to establish by that which takes place in our forests, &c.

The changing of animals that has been advocated by him, is equally as erroneous as are the arguments employed to substantiate his system. He says, that "Nature, the creature of the divine Author and Director of all things, without *intermission*, where special interferences do not occur, progresses in a system *prescribed* to her; and employs the most *flagitious* of the human race to destroy, and finally produce a *change, renovation*, or *substitution* in nations or races of men."* And soon after this, speaking of timber and plants, he observes, "these flourish on the destruction of others, as do men and animals, whose number and vigour increase by changes of race and locality."† To convince us of this supposed fact, he says, "how many of the aborigines of South America have been ex-

* See Mem. of the Philad. Agr. Soc. vol. i. pages 33 and 34.
† Idem, page 36.

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tirpated? Nearer home, in our part of the country, whole tribes and nations have been exterminated: their places are now tenanted by those destined to extinguish and succeed them."*

Are we to infer from this, that a strong and successful combination of "the most flagitious of the human race" acts under the broad seal of heaven; and that weaker and less successful villains of the same description of men, are instigated by Satan, and being caught, are justly sentenced by the *Judge* to be hanged up by the neck, that the world may be rid of such inefficient instruments in the necessary changes of men and other animals, "whose numbers and vigour increase by changes of race and locality?" "Whether the purpose be achieved peacefully or violently, by those encircled with diadems, or hordes of savages, not less destructive or fierce, the ends are accomplished."†

The President remarks, "that this picture may not be valuable for its colouring, but the likeness is drawn by the pencil of truth."

History has drawn a shocking picture of the miseries inflicted by wicked men. I do not, however, recollect, that it says "The divine Author and Director of all things employs the most flagitious of the human race" to effect this evil; and however different the opinions of Christians may be on other subjects, they all agree in the moral obligation of man. Also, that offensive and unprovoked war is immediately opposed to the doctrines contained in the New Testament. If it were just to employ the "most flagitious of the human race, to destroy and produce a *change, renovation,* or substitution of nations and races of men," for the express purpose of increasing the numbers and vigour of them, it would not be wise, unless men had been constructed like certain worms, which are multiplied by being cut into pieces.

Although man, and most other animals, are endowed with the power of removing from one place to another, and many of them to ramble wide, and some far distant from their native soil, vastly more live and die on it without the aid of the sword or tomahawk; and numerous animals are as incapable of removing from the spot where they were first propagated, as plants, and the circle in which many others move is very circumscribed, yet this does not seem to hasten their destruction.

The immense heaps of oyster shells which cover the grounds, near to the rivers and creeks in our older settlements, where this shellfish is found, seem to determine that notwithstanding they are as located as plants, they have existed there at least ever since the aborigines inhabited this country. As they still exist in the same places, (except when a very increased population has destroyed them,) while the Indians, whose wandering habits, seem much less likely to render their very partial locality burthensome to nature, are destroyed, it clearly appears that the evils arising from the locality of them, did not render it necessary to extirpate them

* See Mem. of the Philad. Agr. Soc. vol. i. page 34. † Idem, page 36.

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and introduce Europeans: consequently that heaven had no more to do with the destruction of the savages "nearer home" than it had with the inspiring that thirst for gold which induced the Spaniards not only to butcher, but also to inflict the most cruel tortures that monsters in human shape could devise, on the unoffending inhabitants of South America. If supernatural agency were employed in this horrid massacre, Satan must have been the promoter of it, if Milton has drawn his *picture* with the pencil of truth.

The knowledge we have of that very ancient and numerous nation the Chinese, as well as the very located habits and customs of this very singular people, is in itself sufficient to teach us that the same race of men may long occupy the same soil, before infinite wisdom and benevolence will find it necessary to relieve nature of the oppressive burthen occasioned by their locality, by commissioning "the most flagitious of the human race to destroy them;" for the express purpose of "renovating" the soil by the introduction of the most profligate of men.

It was once a generally received opinion that, unless merino sheep were kept rambling from one place to another, they degenerated. It has, however, since been clearly proved, that this rambling savage like practice was actually injurious to them; as a fixed residence has greatly improved that very valuable animal.

As it clearly appears that no proof can be brought either form the habits of men or inferior animals, or from the revolution in nations, or in the different classes of animals, that the changes of the latter from one neighbourhood or country to another, are productive of any good, when change is the only object, reason dictates that the farmer should improve his present live stock by every rational means, until an opportunity offers to change for such stock as are evidently superior, or may better suit the soil, climate, or purposes.

Although it has been proved that nature sets the example of change in vegetation, and extensive means have been provided to effect this purpose, as this is not done by the introduction of distant seeds, or the creation of new plants, but by a succession of different plants grown from seeds propagated on the same ground, there is nothing in the economy of nature that ought to induce the cultivator to change his seed, unless it be for better varieties, or for such as may suit his soil, climate, or purposes, better than those he may happen to have.

The change for change sake, naturally places him much in the same situation as is the wandering Arab, who never continues long enough in one place, to admit the practice of valuable improvement to any considerable extent.

In fact, the practice must have originated among barbarians, whose wandering, idle habits, and circumscribed ideas, naturally led them to seek it in change; than which there can be scarcely any thing introduced, that is more extensively injurious to agriculture. It strikes immediately at the root of all rational improvement. No

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man who believes in this doctrine can, without acting inconsistently with his opinion, attempt to improve the properties of either his seed or animals, as he believes that notwithstanding all his efforts, "locality" must and will degenerate them.

The farmer, however, should never forget, that a judicious change or rotation of plants on the same soil, is not only sanctioned by nature, (which we should always consult,) but also by reason and practice.

I would have transgressed too much on the room in Mr. Poulson's paper, if I had explained fully how nature manages the forests committed to her care. The following remarks, together with what has been advanced on this subject in the foregoing chapters, will, I trust, explain the phenomenon.

It will be seen, in the white pines selected for my experiment, that the diameter of the middle sized tree had greatly exceeded that of the smaller one in proportion to age. Also, that the largest sized tree had, in proportion to the age of it, still much more exceeded the growth of that of the second size; and that which is called the annual growths increased in width in the heart-wood, in direct proportion to the growth of the trees.

I have before observed, that after the trees in our forests have been destroyed, the succeeding young plants come up extremely thick; and that in the struggle for life, the weaker ones are destroyed. Also, that during the process the supernumerary branches are trimmed by shade.

This causes the growth, even of the surviving plants, to be extremely slow, for a great many years; and although they are annually making more room for the growth of their tops and roots, by destroying their underlings, and of consequence gradually increase faster in size; they do not grow with much rapidity, until all the plants have been destroyed, which nature had observed would be injurious to the number which the soil is capable of perfecting.

After this has been done, the close shade of the surviving plants keeps under any young tree that may happen to spring up among them: even if, from its nature, it would have been able to contend with those, now to much above it, if it had sprung up with them.

Hence it is, that we often see tall but surprisingly slim trees, which, no longer capable of supporting their own weight, had bent down until their tops rested on the ground. To obtain sufficient air to keep them alive, they had been compelled to spindle upward, in place of maintaining the usual thickness of trees of the same description.

While I lived in the vicinity of Philadelphia, I heard there were white pines growing at the distance of about ten or twelve miles. My gardener was sent to examine whether they might be replanted. On his return, he told me he was informed by the woman who owned the land where the trees grew, (but whose name I have

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forgotten,) that the whole of them had sprung up in the same year in an old field, although it was not remembered, that any white pine had ever grown in that neighbourhood. He also said, that a number of them had been trimmed, and the supernumerary plants removed, that these had grown to four or five inches in diameter across the but, and were handsome; but that the trees which had not been trimmed although much smaller, and fitter to remove, had ugly ,little, ragged looking heads. This induced me to send for most of the smallest size that could be got among the trees which had been trimmed, &c. and but a very few of those growing in the thicket.

I found the trimmed trees were at least double the height of those got from the thicket. In the diameter there was still much more difference. I believe one of those which had been trimmed would have weighed five or six times as much as one of the others.

When I removed to the back woods, neither these circumstances nor what had been written in the memoirs on the changes in timber &c. were forgotten by me. What I have advanced in this work, on this very interesting subject, is the result of much attention, observation, and minute inquiry, and I trust in all material points will stand the test of ages yet to come. However, we have yet very much to learn respecting the economy of plants, which, if it be ever correctly understood, must be taught by science judiciously directed, as common science and observation can do but little more than detect obvious errors, and point out facts that are equally as readily seen. But as common sense and observation, in plain practical cases, are capable of determining between science, and what pride and folly have attached to it, the practical farmer who can write so as to be understood, should not be silent when the interests of agriculture are involved.

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CHAPTER VII.

It is shown that any one of the earths when enriched with animal and vegetable matter, will produce luxuriant vegetation, but that no mixture of them will produce the same effect without the aid of these substances The practice of paring and burning the soil is considered. How substances originating in animal and vegetable matter may recede or depart so far from their original form, as to retain but little if any nutriment for plants. The theory of the usefulness of carbonaceous matter as manure, has been carried quite too far.

A FAVOURABLE mixture of the different earths in soils, is well known to be highly interesting to the farmer. But no combination of those substances can be useful to agriculture without the aid of animal or vegetable matter. This is seen in old worn out soils, be their earthy texture what it may. Nature, always intent in propagating animal and vegetable life to the utmost extent wherever it can be done, never suffers such soils to be entirely stripped of vegetable and animal matter; still from the scanty produce obtained from them, it seems to be determined, that no valuable vegetation is to be expected from the earths alone.

Seeds contain in themselves enough of rich nutritive matter to support the infant plant,* still the vegetation of them is slow and precarious in a poor soil, and much more so in earth alone. Unless a soil calculated for the growth of plants lie under the inert earth, and the roots of the infant plants are sufficiently vigorous to find their way into it, (as may happen in soils that have been trench ploughed,) the plants will either die or be of little worth. The enriching volatile matters arising from the living as well as from the fermentation and decomposition of dead animal and vegetable substances, is continually floating in the atmosphere. These have been found sufficient to keep some plants alive, when seemingly separated from every other source of nourishment: still this supply alone cannot afford a sufficiency of nutriment for plants in general. Even the wonder working powers of gypsum have been found insufficient to operate on the inert substratum of a thin soil, that has been turned uppermost by trench ploughing, unless animal and vegetable matter be applied.†

In some of our forests calcareous matter prevails. In others no limestone is seen. In some of those extensive wilds, the different earths seem to be very advantageously blended. In other parts clay abounds; and then again we find that sand greatly prevails: still, na-

* It cannot, however, in the earliest stages of its growth be luxuriant, unless the additional nutriment required by it is supplied by the soil.

† See Mem. of the Philad. Agr. Soc. vol. i. page 243.

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ture grows luxuriant crops on all those soils, merely by keeping them well stored with animal and vegetable matters. This seems to supersede the necessity of a more intimate combination of the different earths.

When the farmer clears on any of these soils, he obtains luxuriant crops, until his folly has destroyed the greater part of the animal and vegetable matter which nature had been accumulating for ages: therefore, we hear but little, if any complaint of the earthy ingredients in his soil, until he has exhausted it by perpetual ploughing and severe cropping. When this evil has been effected, we hear loud complaints of a superabundance of clay or sand. It is then said the cold stiff retentive clay is commonly too wet, or else too dry to be advantageously cultivated. The plants are either injured by an excess of moisture, or the hard baking of the earth. The inclement weather in the winter or early in the spring, heaves them up, and they are destroyed by frost.

Also, that the open texture of the sandy soil, greatly promotes evaporation. Unless the seasons happen to be dripping, the earth is blown from the roots of the plants, and they are killed or greatly injured by drought or frost.

If the farmer had been as careful as nature was, to keep the grounds well stored with animal and vegetable matter, little or no complaint against the earthy texture of his soil would have been heard. The partly decaying vegetable substances would have divided the adhesive soil. The fermentation and decomposition of them would have expanded, and still more minutely divided it, for the ready admission of the roots of the plants. Likewise furnished sufficient nutriment to invigorate and enable them to withstand the inclemency of the seasons: even under the present general system of cultivation, which is by no means calculated to produce an extensive operation of these invaluable effects.

A sufficiency of vegetable and animal substances incorporated with a sandy soil, very much retards evaporation. They also invigorate the plants. This enables the roots to penetrate deeper and extend wider. Luxuriant foliage is likewise promoted, and this defends the soil by its shade; and where a proper system of cultivation is practised, a much better texture of sandy as well as of clayey soils is also obtained, through the medium of the grasses.

I have been the more particular to show that any one of the earths, when enriched with animal and vegetable matters, will produce luxuriant vegetation, and that no mixture of them will produce the same valuable effects without the aid of these substances. Also, that the application of none of the manures generally termed stimulating, or any combination of them, is capable of preserving the fertility of any soil subjected to cultivation, as all the books which I have seen on agriculture, (however correct they may have been in some other respects,) recommend an immense and useless waste of animal and vegetable matters, by improper management, either before or after the manures have been applied. But most generally both before and

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after the application of them, and this very generally through the medium of much useless as well as very injurious labour.

Sir Humphrey Davy's Lectures on Agricultural Chemistry, have guarded against the waste of animal and vegetable matters, more than any other publication that I have seen: still it may be proper before I proceed further, to point out where he exposes these substances to useless, injurious and expensive waste.

He says, "the great objection made by speculating chemists, to paring and burning is, that it destroys vegetable and animal matter, or the manure in the soil; but in cases in which the texture of its earthy ingredients is permanently improved, there is more than a compensation for any temporary disadvantage; and the carbonaceous matter remaining in the ashes, may be more useful to the crop than the vegetable fibre from which it was produced."*

However "speculating" these chemists may have been, in this instance they are supported by facts so obvious, that it seems wonderful how any chemist or farmer who employs observation, could believe otherwise. However, as the value of animal and vegetable matter has never been properly appreciated or explained, Sir Humphrey is by no means singular in his opinion of paring and burning. To prove the utility of this practice, he observes, "I have examined by a chemical analysis, three specimens of the ashes from different lands. The first was sent to the board by Mr. Boys, they were from a chalk soil, and 200 grains contained,

Carbonate of lime,	80
Gypsum,	11
Charcoal,	9
Oxide of iron,	15
Saline matters,	3

Sulphate of potash,
Muriate of magnesia, with a minute quantity of vegetable alkali.
The remainder alumina and silica.

"Mr. Boys estimates that 2,660 bushels are the common product of an acre of ground, which gives 172,900 lb. containing,

Carbonate of lime,	69,160
Gypsum,	9,509.5
Oxide of iron,	12,967.5
Saline matter,	2,593.5
Charcoal,	7,780.5" †

"The second specimen, a soil containing four per cent. carbonate of lime, and consisting of three-fourths light silicious sand, and about one-fourth clay. This had been a turf before burning, and 100 parts of the ashes gave,

* See his Lec on Agr. Chem. page 340.
† Idem, page 346.

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6 parts charcoal,
3 do. muriate of soda and sulphate of potash, with a trace of vegetable alkali.
9 do. oxide of iron.
The remainder earths."*

"The third instance was a stiff clay. 100 parts of the ashes contained,

8 parts charcoal,
2 do. saline matter, principally common salt, with a little vegetable alkali.
7 do. oxide of iron,
2 do. carbonate of lime.
The remainder alumina and silica."†

Sir Humphrey remarks on the first specimen, "In this instance there was undoubtedly a very considerable body of matter capable of being active as manure *produced* in the operation of burning. The charcoal was finely divided, and exposed to a large surface of the field, must have been gradually converted into carbonic acid, and the gypsum and oxide of iron, as I mentioned in the last lecture, seem to produce the very best effects when applied to lands containing an excess of carbonate of lime."†

This gentleman speaks as if the carbonate of lime, gypsum, and oxide of iron had been introduced by the burning. He must have known better. This process neither increased the quantity nor altered the properties of either of them, as may be readily proved from his own testimony. Chalk is a carbonate of lime, consequently the chalk soil furnishes an abundance of this article. The properties of it were not altered by the burning is evident, as after this, he calls it carbonate of lime. Now Sir H. tells us that a soil should be heated red hot for half an hour, to discover whether gypsum existed in it.‡ Therefore, we must conclude, that he does not believe that paring and burning of the soil, will produce it where it did not exist before.

Of the oxide of iron he elsewhere observes, "Dr. Darwin, in his Phytologia, has supposed that clay, during torrefaction, may absorb some nutritive principles from the atmosphere that afterwards may be supplied to plants; but the earths are pure metallic oxides, saturated with oxygen; and the tendency of burning is to expel any other volatile principle that they may contain in combination. If the oxide of iron in soils is not saturated with oxygen, torrefaction tends to produce its further union with this principle, and hence in burning, the colour of clays changes red. The oxide of iron containing its full portion of oxygen has a less attraction for acids than the other oxide, and is consequently less likely to be dissolved by

* See his Lec. on Agr. Chem. page 348.
† Idem, page 348. ‡ Idem, page 171.

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any fluid in the soil; and it appears in this state to act in the same manner as the *earths*. A very ingenious author, whom I quoted at the end of my last lecture, supposes that the oxide of iron, when combined with carbonic acid, is poisonous to plants; and that one use of torrefaction is to expel the carbonic acid from it; but the carbonate of iron is not soluble in water, and is a very inert substance, and I have raised a luxuriant crop of cresses in a soil composed of one-fifth carbonate of iron, and four-fifths carbonate of lime.* Thus we see this "active manure" is reduced by the gentleman himself to the level of common "inert earth."

Much stress is laid by Sir H. on the advantages to be derived from the finely divided charcoal, which appeared so plentifully in this experiment. It could not have been any thing like so finely divided as was that which he reduced to impalpable powder previously to putting it into the phial of water, in which his experiment plant of peppermint was growing. Certainly the result of that experiment was not such as to induce him to say any thing in favour of this almost indestructible substance, which in the case of paring and burning, seems to be his favourite manure.

Here I would, however, ask how it happens that Sir H. does not enumerate the salts contained in the ashes, as a part of the active manure obtained by the burning, especially as they were considerable in this, as well as in the other two samples of soil analysed by him? It also clearly appears that they were the only manure which was introduced by the burning, except the gaseous effluvia which may have lodged in the earth as the smoke, &c. passed through it, during the slow smothered heat which very gradually consumed or charred the animal and vegetable matter contained in and upon the soil, previously to the paring and burning of it. Had he forgotten that he previously told us these salts were "a part of the true food of plants?" Or was he apprehensive that the plain practical farmer would dispute the merit of the charcoal, if the powerful agency of the alkaline and saline salts was acknowledged; as it had been generally believed by this class of cultivators, before the absurd theories founded on charcoal were started, that the salts contained in the ashes produced the fertility which followed paring and burning? Although the salts existing in the ashes afford no nutriment for plants, long and extensive practice has clearly determined them to be powerfully stimulating manures.

As, agreeably to Sir H.'s own theory, it does not appear, that the sandy soil could be benefited by opening the texture of it, I shall pass on to the third specimen, particularly as this gentleman says, "Many obscure causes have been referred to, for the purpose of explaining the effects of paring and burning; but I believe they may be referred entirely to the diminution of the coherence and tenacity of clays, and to the destruction of inert and useless vegetable matter, and its conversion into a manure."† "And in all cases in which

* See his Lec. on Agr. Chem. page 350. † Idem, page 349.

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the texture is already loose, or the organizable matter sufficiently soluble, the process of torrefaction cannot be useful."*

In his remarks on the third specimen, he observes, "This land had been brought into cultivation from a heath, by burning, about ten years before; but having been neglected, furze was springing up in different parts of it, which gave rise to a second paring and burning." Likewise, that "here the quantity of charcoal was greater than in the other instances;" and that he suspected, "the salt was owing to the vicinity of the sea, it being only two miles off."†

As a productive soil is seldom neglected, may we not infer that this neglect originated in the impoverishing effects produced by the first paring and burning? Especially as it is very observable that when the management of the soil after paring and burning has been detailed, the success depended on the use of much enriching manure, unless where the grounds were very quickly returned to grass.

In the former case cropping may be perpetual on any soil capable of cultivation. In the latter, the animal and vegetable matter which remains after the burning is not entirely exhausted by cultivation, before grass seeds are sown. The powerful action of the salts decomposes the vegetable matter, and the grasses being thus invigorated, furnish abundant food for cattle and animalcula, which naturally introduce animal matter also.

It should be, however, well remembered, that it is to the grasses, and not the burning, that the agriculturist is indebted It is the vegetation introduced by them that makes the improvement, if any there should be, and that prevents the ruin of the soil. However, as this vegetation, and the animal and vegetable matter obtained by it, might have existed to as great or greater extent without the burning, the animal and vegetable substances destroyed by this inconsiderate practice, are for ever lost to the cultivator; although it might have been saved, and valuable crops obtained, if a proper system of management had been pursued.

But as the usual practice of husbandry is better calculated to destroy much of the animal and vegetable matter, than to bring the whole of it into the most active and lasting use, the difference between burning these invaluable substances, and that of exposing them, by an injudicious cultivation, to the destructive effects of the sun, air, &c. though very considerable, has not been sufficiently appreciated by many cultivators: therefore the barbarous practice of burning the soil has been perpetuated, and is now advocated by some of the best farmers, and most enlightened chemists of the present age. The product obtained by this practice is tempting, while the salts contained in the ashes continue powerfully to excite the animal and vegetable matter, which escapes the burning, to a hasty and unnatural fermentation and decomposition. This greatly facilitates the growth of the crops; but as speedily terminates in the destruction of the animal and vegetable matter, unless the soil

* See his Lec. on Agr. Chem. page 350. † Idem, page 349.

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was uncommonly deep and rich before the burning took place. This evil, however, appears not only to be overlooked by many, but the practice is also highly recommended by them; in consequence of its having succeeded in the hands of Mr. Boys, and other wealthy and distinguished cultivators, who possess the means of making much manure, and know full well when and how to apply it, in sufficient quantities, to counteract the loss sustained by burning of the greater part of the animal and vegetable matter, and the hasty decomposition of the remainder. If, however, the extra labour, together with the value of the manure necessary to keep up the fertility of the greatly injured soil, were fairly estimated, much loss, instead of profit, would appear, especially if the product, for a succession of years, were contrasted with that obtained from grounds of equal quality, which had not been burned, but judiciously cultivated. In the latter practice, the animal and vegetable matter contained in the land would be applied to the growth of the crops, and improvement of the soil, in place of being exposed to the useless waste, which naturally arises from the usual inconsiderate system of cultivation.

To illustrate this, it becomes necessary to describe, very briefly, how the soil now under consideration, should have been cultivated. We are told, furze was springing up in the different parts of it. The manner, however, of telling this, seems to imply, that they were neither very numerous nor large. If any part of them were too large to be ploughed under the soil, these might have been cut off close to the ground; or if their roots were too stubborn to be turned under by the plough, grubbed up, and burned, and the ashes in either case profitably applied. It is not said whether the grounds had been artificially covered with grass, or left to be covered by nature, with such plants as she could introduce. This, however, is of little consequence, as in either case we observe the soil must have been covered with vegetation; for the charcoal greatly exceeded that produced by the second specimen, which we are informed was a turf. This vegetation, except that part of it which was too stubborn, might have been ploughed under the soil.

We may readily make a tolerably correct estimate of the amount of vegetation above the soil, for it is seen. If the earth be carefully removed from a soil of grass cut out sufficiently deep, the number, size, and texture of the roots seem to justify the opinion, that they will weigh as much as the full grown tops proceeding from them, and it would seem that the same may be expected from the roots of the plants generally called weeds. On a lay, well stored either with grass or weeds, any fallow crop that the soil is capable of producing, may be very advantageously grown, and followed by wheat or any other small grain. After these crops have been removed, a considerable proportion of the animal and vegetable matter that was at first contained in the lay, will remain for the use of the grasses; which ought always to follow the second cultivated crop, when the soil is rather thin, and enriching manure cannot be applied for the first crop.

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If a proper system of cultivation be pursued, all the animal and vegetable matter that it seems possible to reclaim from the multiplied avenues of useless waste, will be saved; and if, as in the case now under consideration, the soil happens to be a retentive clay, a much dryer, and vastly more open and freer soil is obtained for the roots of the plants, than can be furnished by paring and burning. When the grass or weed lay is turned, each furrow-slice forms an under drain; especially when the crop of grass or weeds which has been ploughed under is luxuriant.

The innumerable roots that fill the soil in every direction, minutely divide it. The fermentation and decomposition of them and of their tops expand and open it. This with the cavities or holes formed by the gradual decay of the roots, prepare an open, free, artificial bed, well stored with nutriment, and properly calculated to admit the roots of the plants readily to pass through it, in every direction, in search of the food provided for them.

The fermentation that takes place in the soil is never interrupted, or the nutritious matter arising from it exposed to useless waste, as is done by the usual, but very erroneus practice of turning up the sods when the crop is cultivated. Of consequence nothing is lost that could be saved. It is also certain that there is nothing but fire, or some cause which acts with equal effect, that can destroy weeds or any other vegetation injurious to crops, more effectually than fermentation when it is properly directed.

If the lay be well turned and the crop cultivated by the hoe harrow, (called by some a scuffler,) with the tined harrow following it, the weeds and grasses are cut off by the first implement a little within the surface of the soil. The vegetation separated by it from that lying still lower within the ground, is overturned and effectually mangled by the tined harrow. The weeds and grasses within the soil being severely wounded by the hoe harrow, and closely covered by the earth above, the fermentation of them is powerfully promoted every time the fallow crop is cultivated.

Still some hardy plants, and also others which are less hardy, but more favourably situated, will escape. It should, however, be recollected, that even the savage and destructive practice of paring and burning does not entirely extirpate either: also, that fermentation keeps the soil open and mellow, so long as a sufficiency of animal and vegetable matter remains in it. As the small grain is put in by the hoe harrow with the tined harrow following it, the sod is not disturbed either before or after the seed for this is sown. Consequently, the seed of weeds, which lay buried beyond the power of vegetation is not turned up, to poison the crop or the grasses following it.

Neither are the rich matters within the soil exposed to useless waste. I have been compelled prematurely to introduce this very concise description of some of the substantial advantages obtained by a proper cultivation, that the reader may contrast them with the fleeting resources, and ruinous consequences, arising from burning the soil.

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To show that burning a clay soil ameliorates the texture of it, "if a piece of brick earth be applied to the tongue, it will adhere to it very strongly, in consequence of its power to absorb water; but after it is burnt there will be scarcely any sensible adhesion."*

There is no brick made here; therefore, I cannot try this experiment. But as I have always understood that a pure clay will not make good brick, unless a considerable quantity of sand be mixed with it, and find that a new pipe stem (which seems to be formed of pure clay) adheres very powerfully to the lip, it would seem that the gentleman may have been greatly mistaken in this experiment. Be this, however, as it may, he should have recollected that it requires a very intense heat to form a brick.

The inflammable matter contained in a soil which is pared and burned, is too inconsiderable to act powerfully on the great body of earth with which it is mixed. Especially as the combustion proceeds so slowly that a great deal of the vegetable matter is only charred; and a part of it remains unburned; therefore, when clay or tenacious soils are pared and burned, they cannot be brought "much nearer to a state analogous to that of sands."† Yet as the heat is sufficient to expel the greater part of the moisture, provided the weather happen to favour the process, the "burning may convert a matter that was stiff, damp, and consequently cold, into one powdery, dry and warm; and much more proper as a bed for vegetable life."‡ But this improvement extends no further than this earthy texture of the soil, and except from the moisture introduced by the salts in the ashes, can be but little, if at all, more permanent, than that obtained by a well directed naked fallow, executed in the usual way, when the weather proves favourable for performing the work.

Although the latter practice uselessly destroys much of the animal and vegetable matter, it is a very saving one when compared with paring and burning, or that truly ingenious agriculturist, J. Tull, could not have continued so long to grow a regular succession of exhausting crops, on the same ground, without the application of manure of any kind; especially as the lands cultivated by him were naturally thin.

We do not pare and burn soils in the back-woods; but we see the effects of fire on them, both on a very extensive, and also on a very limited scale, not only on fresh soils, but also on older ones, as long as any of the girdled timber remains on them. I shall, therefore, describe our practice, and the effects produced by it on an old field that has been neglected, as this suits my present purpose best.

Previously to the cultivation of it, it is absolutely necessary that the obstacles should be removed. In fact, the practice of burning is so very prevalent that it seldom happens that we can cultivate a field where the timber has been girdled, until considerable labour

* See his Lec. on Agr. Chem. page 346. † Ibid. ‡ Ibid.

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has been first employed in removing the fallen trees, limbs, bark, &c. Therefore, we are compelled to become well acquainted with the effects of fire on our grounds. But to return to the old fields now under consideration: the fallen timber is cut up into proper lengths, hauled or rolled together, heaped up, and burned. The brambles and sprouts cut off close to the ground, and the grubs rooted out. These, with the bark, brush, chips, &c. are gathered by the hand, and raked into small heaps, and also burned. It, however, often happens that the ashes arising from burning the heaps are not spread, except the little that is done towards spreading them by the plough and the harrow in the cultivation of the soil.* Therefore, if the crop happens to be wheat, or other small grain, it often falls or lodges where the heaps were burned, but is less likely to be injured by superabundant luxuriance where the grubs, brush, brambles, &c. were consumed.

Thus accident furnishes the means of much more correct information of the effects of fire on soils, than any chemical experiments that have been, or, perhaps, ever will be made; or than is likely to be gathered from the practice of paring and burning.

This being the case, the back-woods' farmer, at one comprehensive view, may readily see the effects produced by every different grade of burning, and on every different kind of soil: also, on new as well as on older grounds. He may likewise readily discover the effects produced by the different grades of burning, by comparing what takes place where the log, brush heaps, &c. were burned, with what happens in the grounds around them which have not been subjected to the burning.

The salts contained in the ashes where the heaps were burned, especially where the log heaps were consumed, keep the soil so moist for some time after the grounds have been cultivated, that until I have got near enough to investigate the cause of this moisture, I have sometimes thought that it proceeded from spouts or feeble springs. This moisture causes the crops to be as luxuriant on sandy soils as on clay. It counteracts the injurious effects produced by too great evaporation, which generally takes place in sandy grounds after they have been robbed by burning, or an injudicious cultivation of the greater part of the animal and vegetable matter that had previously existed in them. It also prevents the clay soil from baking, and becoming impervious to the roots of the plants, which, in general, does much more injury to the crops than the excess of moisture which prevails in any soil that is not too wet for the growth of cultivated crops.

But, it should be remembered, that as soon as the salts contained in the ashes have exhausted the animal and vegetable matter, which

* I was not a little surprized, when I first removed to the back-woods, to find that vegetation, in place of being destroyed by the very large quantity of ashes lying within the compass of the spot where a log heap had been burned, was commonly much more luxuriant than on any other part of the ground, unless the soil was in general rich enough to produce luxuriantly.

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had escaped the burning, and on which they so very powerfully act, the places where the heaps were burned are clearly seen to be the poorest parts of the field, unless enriching manure has been applied, or the grounds have been laid down in grass, in time to prevent the full extent of the injury done by the burning, from being so readily seen. As the grasses, however, are but too seldom sown, and but little, if any, manure used by too many of the farmers in the back-woods, the facts which I now relate, are not only clearly seen, but acknowledged by the most of them. When a soil is pared and burned, a part of the nriching and estimulating volatile matters arising from the burning, lodges in the heaps of earth, and furnishes some manure for plants. As a red and intense heat is not produced, the matter deposited by the smoke proceeding from the slow and smothered combustion, is not consumed. Now, as this matter, and the salts contained in the ashes, are the only active manures obtained by the burning, is it not strange that Sir H. (who is, no question, a very excellent chemist,) should overlook those active manures, and lay so great a stress on charcoal, and also on substances which are neither altered nor created by the burning? But it would appear that too many farmers, chemists and philosophers, have yet much to learn respecting the nature and properties of manures; for nearly the same takes place when clay is burned for manure, as when the soil is pared and burned. Still this very inconsiderate and equally expensive practise, has been, (more especially of late,) highly recommended by farmers and philosophers. Although nothing is found in the united mass after it has been burned, to remunerate the credulous practitioner, but the salts contained in the ashes arising from the fuel employed in the burning, and the volatile matter lodged in the clay, as is the soot and rich matters lodged with it at the sides of our chimneys, but in greater quantities to the proportion of fuel expended, as the clay opposes the rapid progress of those matters through it.* But even this is a rational practice, when compared with paring and burning. For although it produces little, when compared with the labour or money this little costs, it does not destroy an immense quantity of invaluable enriching manure.

Sir Humphrey certainly seems to expect vastly too much from charcoal. We may all see that it is slowly wasted by the destroying hand of time, and agree with him that it produces nutriment for plants: still it is difficult to believe that this nutriment is supplied with sufficient despatch to make it an object of any considerable moment to the farmer, except in those few cases where the fire has acted so weakly as only very partially or imperfectly to char the substances which may happen to have been exposed to a degree of heat, not so far exceeding that produced by a natural fermentation, as to render the vegetable matters any thing like as inert as charcoal.

* When charcoal is burned, the wood is covered with the ground nearest to it. This ground becomes highly saturated with vegetable matters, and is a valuable manure, be the texture of the earth what it may.

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This gentleman observes, that "in April, 1803, I enclosed some well burned charcoal in a tube half filled with pure water; I opened the tube in the spring of 1804: the water in the tube, when mixed with lime water, produced a copious precipitate; so that carbonate acid had evidently been formed and dissolved by the water."*

This seems to determine, that, if charcoal be favourably situated, some enriching matter is formed. It, however, also determines that the experiment was twelve months in operation, and that, at the expiration of this time, Sir H. does not say how much of the charcoal had been wasted, or how many more years it would require to convert the whole of it into what is called carbonate acid by him, although this might, and ought to have been done, before he so highly recommended that substance for manure: more especially as he tells us "the carbonaceous matter remaining in the ashes, may be more useful to the crop than the vegetable fibre from which it was produced."†

This is rating charcoal very highly, and greatly depreciating the value of the vegetable fibre. It requires many pounds weight of the latter to make one pound of the former. After it has been purchased at this very extravagant rate, neither Sir H.'s experiments, nor any others known to us, determine whether the whole of it could be brought into active use for a century to come.

Yet this gentleman, in his observations on the three specimens of soil, seems to overlook the great value of the salts contained in the ashes, while he powerfully impresses the value of the charcoal.

On the first specimen he observes, "the charcoal was finely divided; and being exposed to a large surface of the field, must have been gradually converted into carbonic acid." And on the second, "in this instance, as in the other, finely divided charcoal is found; the solubility of which would be increased by the presence of alkali."‡ And on the third, "here the quantity of charcoal was greater than in the other instances."

It is surprising that Sir H. who is so very careful to preserve even the dry vegetable fibre from waste, as to recommend in place of fermenting straw, to "have it chopped small, and kept dry, till it is ploughed in for the use of the crop,"§ should not only recommend burning of dry, but also living vegetation, which might, with much less labour, be ploughed under the soil, where no part of it that it is possible to save, is lost, and where it is brought into immediate action, as well as lasting use: especially as it does not appear that an injurious excess of vegetation existed in either of the three soils now under consideration.

But it would seem that the theory of the nutritious properties

* See his Lec. on Agr. Chem. page 287. † Idem, page 346.

‡ Here alkali is noticed but merely to increase the solubility of the charcoal. The presence of alkali, however, would do but little good, if it found nothing less inert than charcoal to act on.

§ See his Lec. on Agr. Chem. page 284.

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contained in substances that originated from animal and vegetable matters, has been carried quite too far; and that in consequence of this inconsiderate error, philosophers, chemists, and farmers, have expected too much nutriment for plants, from substances that contained but little, or perhaps none at all.

As the application of some of these substances, (in consequence of their stimulating properties,) has been found to promote vegetation to a great extent, too many have been confirmed in the ruinous opinion, that they furnish the nutriment which produces this effect. They should, however, have recollected that the further any substance recedes or departs from that from which it *originated*, the less of the properties of the *original* substance is retained.

Thus, although it seems probable that the shells from which the carbonate of lime is formed, were, in their original state, quite as richly stored with decomposable animal matter, as the bones of animals, time has eradicated this matter.

For "the most common form in which lime is found on the surface of the earth, is in a state of combination with carbonic acid, or fixed air;"* "the true calcareous element, the carbonate of lime, is uniformly the same in nature, properties, and effect, and consists of one portion of carbonic acid, 41.4, and one of lime, 55."†

It is therefore evident, that this combination has departed far from the substances from which it originated, and that but little, if any, enriching matter is to be expected from it.

If wood be burned in our fire places, ashes, coal, and soot are obtained. The ashes depart farthest from the original vegetable substances, and if they retain any enriching matter, it must be little.

The coal, though severely scorched, has not receded or departed so far from the wood; therefore, it still retains some considerable portion of the vegetable matter.

As the soot arising from the smoke is condensed and deposited at the sides of the chimney, much enriching volatile matter, that has been but little, if any, scorched, is deposited with it. The rest escapes, and when the state of the atmosphere favours the descent of the smoke, we often see it hovering over our fields; also, smell it, and feel its effects even in the open air; and no question but the enriching volatile matter conveyed in this way, produces very valuable effects on vegetation.

When barley is malted, enriching volatile matter escapes, but much more of it from the brewer's vat. The beer affords considerable nutriment and stimulus. If the fermented liquor from the vat be distilled, spirit is formed. This has receded so far from the original vegetable matter, that although it is a powerful stimulus, and as useful as it is powerful, but little, if any, nutriment is derived from it; and when too freely used, especially, (as too often happens,) without a regular and sufficient quantity of nutritive matter, its ruinous effects are too well known to require explanation.

* See Sir H. Davy's Lec. on Agr. Chem. page 315. † Idem, page 316.

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This, by the by, is very analogous to the improper use of stimulating manures, which have originated in animal or vegetable organized bodies, but have receded or departed so far from those substances, that they retain but little, if any, nutritive matter for plants.

Sir H. observes, "it is not uncommon to find a number of changes rung upon a string of technical terms, such as oxygen, hydrogen, carbon and azote, as if science depended on words rather than things."* And again, "no one principle affords the pabulum of vegetable life; it is neither charcoal, nor hydrogen, nor azote, nor oxygen alone; but all of them in their various states and combinations."†

This seems to refer the pabulum of vegetation to charcoal, hydrogen, azote and oxygen, in their various states and combinations. I believe, however, it will be found, when the subject has been properly investigated, that charcoal furnishes but little food for plants; and however useful hydrogen, azote and oxygen may be to vegetation in other respects, that they do not afford any nutriment for it, as will be presently explained.

Modern philosophy seems to have made no distinction between the rich "gaseous effluvia, which the putrefying or decaying remains of animals and vegetables, are constantly emitting,"‡ or the rich gas arising from a brewer's vat, and that which constitutes a part of the atmosphere, or forms a part of the carbonate of lime. All these gases are now indiscriminately called carbonic acid gas.

Now it is as evident as almost any other thing can be, that the carbonic acid gas, which has been locked up for ages in limestone, does not possess the same rich nutritious matters as the gases which have recently escaped from a brewer's vat, or from the putrefying remains of animals and vegetables. Consequently, the carbonic acid gas found in limestone, has receded or departed far from the rich original state in which it may have first existed, and affords but little, if any, nutriment for plants.

The properties of the carbonic acid gas, which is said to constitute a part of the atmosphere, are not so readily distinguished from the rich gaseous effluvia which are constantly emitting from a variety of processes, and intermixing with it. If the genuine properties of this gas be, (as there is every reason to believe they are,) the same as that which forms a part of the carbonate of lime, no question but it also has receded or departed far from the rich gaseous matters from which it may have originated; and that but little, if any, nutriment for plants is contained in it.

Sir H. says, "it is shown, by various researches, that the constitution of the atmosphere has been always the same, since the time it was first accurately analyzed; and this must, in a great measure, depend upon the powers of plants to absorb or decompose the putrefying or decaying remains of animals and vegetables, and the

* See his Lec. on Agr. Chem. page 26. † Idem, page 18. ‡ Idem, page 16.

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gaseous effluvia which they are constantly emitting." "Carbonic acid gas is formed in a variety of processes of fermentation and combustion, and in the respiration of animals, and as yet no process is known in nature by which it can be consumed, except vegetation."

"Animals produce a substance which appears a necessary food for vegetables; vegetables evolve a principle necessary to the existence of animals; and these different classes of beings seem to be thus connected together in the exercise of their living functions, and to a certain extent made to depend on each other for their existence. Water is raised from the ocean, diffused through the air, and poured down on the soil, so as to be applied to the purposes of life. The different parts of the atmosphere are mingled together by the winds, or changes in temperature, and successively brought into contact with the surface of the earth, so as to exert their fertilizing influence."*

These agents are heavily laden with rich fertilizing matters, and winged with despatch. Still, among this mighty mass of matter, some substances will exist, that nature herself cannot bring into immediate active use: but as she has neither designed nor constructed them for that purpose, neither she nor the agriculturist, whom she means to serve, will be disappointed, if he be careful to harmonize nature and reason in the practice of husbandry.

If nature and reason had not been made to bend to favourite theories, the advantage which plants derive from the enriching and fertilizing principles floating in the atmosphere might have been better understood: but as soon as any principle in nature is believed to be more highly important than it was formerly thought to be, almost every beneficial virtue is attributed to it.

The gases have been "rung,"† until nature has been silenced and reason deafened with the sound: especially the carbonic acid gas, formerly called ærial acid;‡ also, fixed air;§ "as if science depended on words, rather than things;‖" or, indeed, on an alteration of words.

It seems that, as all animal and vegetable matter may be reduced to carbonaceous substances, it has been concluded, that they also must be the best preparation for the food of plants; although a little more heat would convert the charcoal into ashes, which would still be the remains of the animal and vegetable matter; and, being a very powerful manure, may, at some future day, as systems are continually changing, be considered still more efficacious: especially after the parers and burners of the soil, who of late have placed great confidence in charcoal, find it infinitely inferior to ashes for manure.

All nature has been ransacked for carbonaceous substances: the diamond has not escaped. Sir H. tells us, it "cannot chemically

* See his Lec. on Agr. Chem. pages 16 and 17.
† Idem, page 26.
‡ Idem, page 21.
§ Ibid.
‖ Idem, page 26.

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be distinguished from pure carbon,"* and determines the specific gravity of the latter by that of the former. However, we do not yet learn, that this costly gem has been used for manure, even in the flowerpots of the richest chemical practitioner.

All living, as well as decaying animal and vegetable substances, are continually emitting volatile enriching and fertilizing matters. The means used for conveying and spreading this matter have been described; and as it is clearly seen that maize gathers and advantageously applies this nutriment, before its specific gravity, which is greater than the common air, causes it to sink to and incorporate with the soil, there is reason to believe, that all plants possess the same power, in a greater or less degree, although the economy of most of them may not be so readily investigated as that of the corn plant.

Nature seems to have a threefold purpose in view, in her management of these fertilizing matters. First, to equalize it; as it necessarily arises in much greater quantities in some places than in others. Secondly, to furnish plants with as much of it as their organs above the soil are capable of gathering and properly applying. Thirdly, to use the remainder within the soil on which it falls; and no question but it adds considerably to the enriching matter contained in it: especially when the vegetation growing on it is well calculated to gather and shield these fertilizing depositions from the injurious influence of the sun and air.

It is therefore, "Neither charcoal nor hydrogen, nor azote, nor oxygen alone. Neither is it," as Sir H. says, "all of them together, in their various states and combinations, that affords the pabulum of vegetable life,"† unless these combinations also embrace the enriching and fertilizing matters described above.

Every farmer in the back-woods so often sees charred vegetable substances, both above and beneath the soil, that he knows charcoal is dissolved or is decomposed too slowly to do him any perceptible good.

Sir H. says, "Oxygen is necessary to some functions in vegetables; but its great importance in nature is in relation to the economy of animals. It is absolutely necessary to their life;" and that "seeds are incapable of germinating, except when oxygen is present;"‡ also, that "the effects of azote, in vegetation, are not distinctly known. As it is found in some of the products of vegetation, it may be absorbed by certain plants from the atmosphere."§ Likewise, that "hydrogen, or inflammable air, is the lightest known substance. It burns by the action of an inflamed taper;" and that water consists of two portions of hydrogen, and one of oxygen;"‖ also, that "the quantity of carbonic acid gas in the atmosphere is very small. It is probably never more than one-five hundredth, nor less than one-eight hundredth part of the volume of air;" and

* See Sir H. Davy's Lec. on Agr. Chem. page 46. † Idem, page 18.
‡ Idem, pages 212 and 213. § Ibid. ‖ Idem, pages 45 and 52.

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that "carbonic acid is decomposed by heating potassium in it; the metal combines with oxygen, and the charcoal is deposited in the form of a black powder."*

But it should be recollected, that this black powder has been still much more severely scorched than the carbonaceous matter left after fermentation and decomposition have completely reduced a dung heap; and that even the cookers of dung seem to think it is too much roasted, when nearly all the gravy has been extracted by the process: as one of the most zealous advocates for cooking it says, "It is questionable whether very old dung reduced to carbon is of any use to vegetation."†

But to illustrate this subject, "Charcoal has been separated from the purest spirits of wine, in the process of making ether."‡ As there can be but little if any nutritive matter in the spirits of wine, there may be, and I believe is, but little if any nutritive matter in carbonic acid gas, notwithstanding charcoal was deposited in the form of a black powder when that gas was decomposed.

Now, if charcoal be what it clearly appears to be, and hydrogen, azote, and oxygen are what Sir H. says they are, I cannot see any use in "ringing" them, or either of them, unless it be to puzzle the plain practical farmer with "a string of technical terms," when he might be much better employed in ploughing or hoeing his grounds: especially if he follow nature and reason in the practice of husbandry; and attentively observe the effects produced by his own mode of management, and compare what he is doing with the practice of others that may happen to be within the compass of his observation.

Chemists have told us, that "putrefaction may be considered a slow combustion;"§ and that "decomposition is effected slowly in the laboratory of nature without great heat, as it is done in our crucibles in a short time by the assistance of great heat."‖

This inconsiderate theory seems to have led to the very injurious opinion, that carbonaceous substances, in which there can be but little if any nutritive matter, afford much food for plants. If animal or vegetable substances be consumed by fire in the open air, the food contained in them for plants is scattered in the atmosphere, and nothing but the ashes remain: if those substances be exposed to a confined heat, as is often done by chemistry, and in the usual mode of forming charcoal, and in paring and burning the soil, the principal part of the food for plants is also scattered in the atmosphere, and by no process known to us, can the little nutriment remaining in the charcoal be brought into active use with sufficient despatch to promote vegetation, to any extent worthy the immediate attention of farmers. It is true, that decomposition sometimes

* See his Lec. on Agr. Chem. pages 210 and 211.
† See Mem. of the Philad. Agr. Soc. vol. i. page 284.
‡ See Domes. Encyc. Amer. edit. vol. ii. page 84.
§ See Dr. Darwin's Phytol. page 215. ‖ Idem, page 211.

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produces combustion, without the artificial application "of great heat," as in hay put into the mow too green, &c. but these are the effect of art.

Nature, when permitted to pursue her own course, acts very differently, as may be seen by the gradual decay of the vegetable substances in our forests, glades, and prairies. The annual plants, leaves from the trees, &c. fall on the ground as winter approaches; these gradually decay, and during the process a certain portion of carbonaceous matter is formed, as evidently appears from the dark coloured matters seen to be mixed in fresh or new soil. It is, however, equally evident, that nothing like so much of the vegetable matter is charred by this slow decomposition, ordered by nature "without great heat," as is charred by the great heat employed by art. Neither is any thing like as much of the nutriment for plants expelled from the carbonaceous matters formed by nature "without great heat;" as is expelled by the much greater heat employed by art to form these substances in a much shorter time. But this is not all, for much more of the nutriment expelled in forming the carbonaceous matter "without great heat" is incorporated in the soil, than is done when these substances are formed "in a short time by the assistance of great heat."

The great dissimilarity between the natural decomposition of the innumerable trees which age, tornadoes, &c. have prostrated in our lonely forests, and that of the wood reduced by art into charcoal, in a short time, with "the assistance of great heat," is still more obvious. The quantity of charcoal obtained in this instance "by great heat," is nearly equal in size to the quantity of the woody fibre of which it is formed; whereas by the very simple but perfect economy of nature, in the decomposition of these huge bodies of wood, but very little carbonaceous matter is formed.

As nature is not interrupted by the rude hand of man, the process is slowly conducted, and commonly underneath the shade formed by the plants growing on the ground. In this case, the mosses first vegetate and grow in the decomposition which takes place in the bark of the fallen tree. The decomposition of a part of the sapwood furnishes nutriment for larger plants. Even the seeds of the largest trees grown on the grounds, vegetate in the decayed sapwood, and sometimes attain their full size. The fallen leaves, twigs, &c. lodge in, among, and between this vegetation, and the leaves blown about by the winds are arrested by the sides and limbs of the fallen tree. This greatly defends the surface, until it gradually decays, and much manure is saved..

There are also plants which nature seems to have formed to delight more in the nutriment found in contact with the decaying wood than with that contained in the soil. The tops of the tea berry, (or mountain tea, as it is called by some,) are quite small, and seldom rise more than four or five inches above the soil; but the roots are very extensive and large. They seem to delight in running underneath the fallen timber or into the crevices formed by

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decay in the wood. In clearing of grounds, I have often observed, when a large fallen tree has been cut up and removed, the whole of the hollow formed in the earth by the weight of it so closely thatched by the numerous and long roots of the tea berry, (which seem to have run and matted from one end to the other of the tree,) that no vestige of the earth was to be seen, and thus vegetation greatly adds to the amount of the manure.

When a tree happens to fall where it is not defended by shade, the bark, after some little time, falls off; the outside of the wood becomes seasoned, (as did the felloes of Mr. Bordley's cart wheels, mentioned before,) and the interior of the tree, like the interior of the felloes, is decomposed. In this case, the thin seasoned shell, on the outside of the tree, continues sound for some time after the inward parts of it have been reduced to a powdery substance; by which means the evaporation from the interior is greatly retarded.

In neither of those cases of decomposition does nature char the woody fibre. For either previously to, or in the ploughing of grounds, which had been recently cleared from their wood, I have often traced the matter arising from the entire as well as the partial decay of the woody fibre of many a tree. It lay partly above, and partly within the surface of the soil. In some instances the whole of the body of the tree was reduced to powder, and no traces of woody fibre appeared. In other cases, more or less of the woody fibre was clearly seen: but in no instance did any thing like charcoal appear. However, as the decomposition progresses beyond the powdery state described above, no question but carbonaceous matter is formed, but not in large and injurious quantities; neither is this carbonaceous matter stripped of any thing like as much nutriment as is that obtained "by great heat in a much shorter time," nor is any thing like so much of the nutritious matters expelled by the moderate heat employed by nature in the decomposition of the woody fibre, as is expelled by "the great heat" employed by art in reducing it to charcoal.

Accident, as well as art, sometimes forms charcoal by a great smothered heat. In this case, if the process be favourably conducted, the coal retains the form, and apparently near the size, of the substances from which it was made. Thus we are told, that "there exists charcoal made of corn, (probably in the day of Cæsar,) which is in so complete a state, that the wheat may be distinguished from the rye."* But it should be recollected, that although the size and form of the grain is yet to be seen, but very little of the rich nutritive matter originally contained in it remains.

"Dr. Priestly discovered, that several of the metals, such as copper, iron, silver, &c. might be converted into charcoal."† Common sense, however, dictates, there is just as much reason to believe, that converting copper, iron, silver, &c. into charcoal, will render them more valuable, for agricultural purposes, as there is to believe that converting animal and vegetable matter into charcoal, (or car-

*See Domes. Encyc. Amer. Edit. vol. ii. page 84. † Ibid.

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bon, as it is now called,) will increase the value of these substances. Here I beg leave to observe, that when it has been proved that the charcoal (or even the salts which Sir H. seems to overlook) arising from the destruction of the animal and vegetable substances, are more valuable than the substances themselves, the soil should be burned; but not until this has been done, unless a superabundance of these substances render the destruction of a part of them necessary to an efficient vegetation.

I will conclude this chapter by observing, that although the plain practical farmer may know but little of the rules of grammar, and less of the theory of science, and "the long string of technical terms by which these gases have been rung," it is certainly high time for him to assert the interest of agriculture, when gentlemen who do understand these theories step so very far aside from nature and reason, as highly to recommend charcoal as a valuable manure for plants; notwithstanding the observations and records of ages determine, that this substance is, in its nature and properties, capable of withstanding the corroding tooth of time so long, that it has been classed among those substances which have been, erroneously, called indestructible.

I have certainly no desire to "ring" technical terms. On the contrary, it is well known to my friends here, that my book on Manures and Vegetation was written in the plain simple language commonly used by plain practical farmers; and that although it explained the economy of nature in our forests, &c. and every thing else which I had then considered necessary to these interesting subjects, the whole was comprised in less than one-third of the extent of the book which I am now writing on these subjects. For in consequence of having seen and considered Sir H. Davy's book on Agricultural Chemistry, after my first book on Manures and Vegetation was written, I was clearly convinced, that unless the erroneous theories advanced by this gentleman were refuted, my labour to promote the interest of agriculture would be in a great measure lost.

It is certainly high time for even those who depend on nature, reason, and observation alone, to oppose the professors of science, when they attach so much consequence to charcoal, as to make it a principal ingredient in "the pabulum of vegetable life,"* and also say, that "no substance is more necessary to plants than carbonaceous matter:"† likewise, that "many plants that grow on rocks or soils, containing no carbonic matter, can only be supposed to acquire their charcoal from the carbonic acid gas in the atmosphere."‡

Here I would ask, what Sir H. can mean by saying plants "acquire their charcoal from the carbonic acid gas in the atmosphere." For although it is highly probable that they may acquire some pure carbon from this source, it is by no means probable, that they also

* Sir H. Davy's Lectures on Agr. Chem. page 18.
† Idem, page 270. ‡ Idem, page 231.

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acquire, or possess any power to apply in any part of their economy, the coal in which carbon is found, after any animal or vegetable substance has been charred either by great heat, or by the fermentation and decomposition employed by nature.

With respect to plants growing "on rocks, or soils containing no carbonic matter," Sir H. should have recollected that the same cause which he says furnished the plants growing on them with "their charcoal" was in continual action; and also in contact with those rocks and soils very long before the plants existed; and that the same causes which conveyed the seed of the plants to the rocks, also conveys, with equal facility, the ingredients necessary to an efficient vegetation.

Now, if in all material points the contents of this and the foregoing chapters be (as I believe they are) correct, it would appear, that although much has been written on the economy of plants, and the nature and properties of manures, but little is well known of either; and that if these subjects be ever "scientifically explained," philosophers must retrace their steps, and depend much less on theory, and far more on practice, united with elaborate observation.

If this had been done, charcoal and the gases would not have been rung, until nature was silenced, and reason deafened with the sound. Neither should we have been told, that the "heart-wood of a tree is dead, and is only useful to elevate and sustain aloft the swarm of biennial plants which cover it. Nor that "gravitation disposes the parts of plants to take a uniform direction." Nor that they "owe their perpendicular direction to gravity." Nor that the sap is raised by the agency of heat and capillary attraction, or by "the expansion and contraction of the silver grain of the wood." Neither should we have been told, that "nothing above common matter exists in the vegetable economy." Nor that "all the simple leaves of plants had an arrangement at night *totally different* from their arrangement in the day; and that the greater number of them are seen at night closed or folded together." Nor that gypsum, the alkalies, and various saline substances, are a part of the true food of plants. Nor that the carbonate of lime acts merely by forming an useful earthy ingredient in the soil.

The celebrity of a philosopher whose talents are highly esteemed, may for a time stamp an ideal value even on his errors. Still, those errors would be eventually detected and exposed, if the gentlemen who followed him in writing on the same subject, would examine facts for themselves, as they stand recorded in the great book of nature "by the pencil of truth," in place of sitting at ease in their libraries, surrounded by a huge collection of books, and forming theories of what is said of nature in them.*

* It is evident, however, that an intimate acquaintance with what is said of nature in those books is highly important, when it is made subservient to practical observation.

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CHAPTER VIII.

It has been wisely ordered that man and animals in general should loathe and reject decaying animal and vegetable substances, and that plants should live on putrescent matter in all the various forms it has been destined to assume. How these matters are spread and intimately blended by Nature over all soils. Farm yard manure loses one-half, when decomposed previously to using it. Laboriously formed compounds considered. It is shown that nature is not deficient in the processes of fermentation and decomposition. The use of stimulating manures considered. Fresh dung highly incorporated with litter, is effectually decomposed after it has been ploughed under the soil, and keeps either clay or sandy soils moister during a dry time than decomposed dung. Top dressing with putrescent manures a very wasteful practice: still the best mode of doing it explained. The loss in manure arising from improper practices considered. A description of the best mode of constructing cattle yards. Also of preserving dung from waste. A description of a common receptacle calculated to save the manures arising in and about a farmer's house.

THE fruitless attempts to make farm yard manure a more proper food for plants, has been a perpetual source of extensive waste and much injurious and expensive labour.

The gentlemen who have attempted to point out the food on which plants live, differ so widely, that it is impossible to believe they understood the subject. It is evident, however, that where decaying animal and vegetable matters abound, vegetation also abounds; and where the soil is deficient in these substances, it languishes and becomes unproductive. Therefore, it seems evident, that these substances afford the proper food for plants; and that nature understands the preparing of them, appears to be proved, by the luxuriant vegetation which generally prevails, where art has not interfered with her simple but perfect system of management.

Plants seem to subsist on the same food as man, and many of them appear to be equally carnivorous, as they thrive much better where animal matter abounds. Still nature, intent on promoting animal and vegetable life to the utmost extent, has wisely ordered, that man, and animals in general, should loathe and reject decaying animal and vegetable substances; and that plants should live on putrescent matters, in all the various forms it has been destined to assume.

But as it was necessary to spread the larger masses of these substances over the surface of the earth, some of the larger animals, and numerous tribes of animalculæ were calculated to live voluptuously on them, and to spread this matter over the ground. Thus we see, when the larger animals die, that in common certain quadrupeds or birds soon devour them, and spread the nutritious matter

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over the soil. Or, when this does not happen, innumerable animalculæ are generated, so soon as the state of the atmosphere favours fermentation. These riot on the carcass until nothing but the bones remain. They then take wing and carry with them the injurious excess of matter, and eventually spread it with compound interest where it will be useful. Even the gaseous effluvia arising from the fermentation of the decaying animal appears to be as profitably applied by nature as any other part of it: in fact nothing seems to be lost by her. What appears to be a waste in one part of her extensive domain, is valuably applied in some other part of it.

Notwithstanding nature is careful to gather and apply the animal and vegetable matters, that the inconsiderate farmer suffers to be exhaled by the sun, scattered by the winds, and washed away by the rain and melting snows, he should recollect, that a great loss is sustained by him; especially if he be in the habit of endeavouring to make the scanty remains of his dung a better food for plants.

Our eyes and nose, without the aid of chemistry, are sufficient to inform us, that farm yard manure loses one half, if it be kept twelve months, and in proportion if it be kept a shorter time, while the season favours decomposition. Yet it appears that philosophers and farmers have long been puzzling themselves and the world with the great advantages to be derived from laboriously formed compounds. They, however, and the world, might have long since seen, that they have generally differed so widely in the nutritive principles said to be produced by these combinations, that the result of their experiments has been better calculated to bewilder than to instruct; especially as they have recommended septic substances to be mixed with farm yard and other putrescent manures, while they applied these substances to destroy the putrid matters arising in privies and elsewhere, and might have seen that the value of putrescent manures consists in applying them in that way which is best calculated to save all their putrid particles, to be diffused throughout the soil.

It is true, some gentlemen have condemned the practise of mixing quick lime with putrescent manures, and have, in the place of it, recommended effete lime, supposing that this mixture introduced certain principles which greatly enhanced the value of the compound.

Lime, however, even in this milder state, promotes decomposition, and is very injurious to the best properties of the manure. Therefore, these unnatural and laborious mixtures should be avoided: at least, until the gentlemen who have recommended them can agree among themselves in what the valuable properties of their expensive compounds consist.

Some philosophers and farmers say, that important advantages are to be derived from mixing rich mould with farm yard manure. It is evident, however, that uniting these substances does not augment them; and that the united mass is but the value of the articles separately. As it is generally believed, that unless the compost be frequently turned, and well incorporated, by much labour

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and expense, it is not properly prepared, by these means much of the riches of the dung escape.

If rich soil be considered necessary to eke out the dung, it should be hauled either before or after it, and spread under or over it; or each spread on separate parts of the field. The latter would be the better practice, as it would determine the comparative value of each.

I have hauled and spread much mould; but the improvement has very generally fallen far short of remunerating the expense. This will always occur, unless the earth be highly impregnated with animal or vegetable matter. It is these substances contained in it, and not the earth, (of which it is commonly principally composed,) that enrich the ground.

If it could be admitted that the mixing of dung and soil together, creates other valuable substances, and greatly enhances the value of the compound, certainly the same effects would be produced, with but very little comparative labour, by turning the farm yard manure under the soil. The substances, in either case, are the same; except that a richer soil is generally provided for the compost; but this is purchased with great labour and expense, and but too often, by impoverishing the woodlands, or some other part of the farm. A full grown crop of the grasses or weeds, grown on the grounds and turned under with the dung, would very generally furnish much more nutriment for plants, than the mould without any additional labour. The dung being evenly spread over, and closely covered within the soil, at a depth greatly favouring fermentation, will be gradually and most effectually decomposed, and spread its riches through it with the least possible loss; and the supposed creation of other valuable principles, would more abundantly take place: especially if the dung be turned under previously to the too general loss sustained by decomposition.

Nature cannot be deficient in the process of fermentation and decomposition, as on these the existence of all animated nature especially depends. That she is not deficient, may be clearly seen by only observing the rapid decay of a post near the surface of the soil. We may also see, that she knows how to concentrate her most powerful efforts, where they are best calculated to promote an important end, as the decay of the post above and below this interesting point, is very slow indeed. This simple post also shows, that too many are very deficient in observation, or they would not have considered nature as incapable of promoting the most obvious and useful operations committed to her care.

This, however, as well as many other things, is best seen in our forests, where she alone presides. There vegetation is much more luxuriant than it is to be found where man is perpetually opposing her perfect economy, by some inconsiderate practice, originating either in barbarism or philosophical theories, misunderstood, or improperly applied.

Nothing can be more effectually accomplished than is the gradual

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decomposition of animal and vegetable substances in the great laboratory of nature. She may, for aught we know to the contrary, very advantageously employ, in this process, causes that are unknown, or not yet well understood by us. We may all see, however, that where a favourable proportion of moisture, heat, and air exists, the fermentation and decomposition of animal and vegetable matters certainly follow. This process is generally more or less rapid, as the substances may happen to be more or less solid. Still, any of the substances commonly used for litter, will be decomposed with sufficient despatch, provided they be well saturated with the rich juices of the cattle yard, and a proper system of cultivation be pursued.

If, however, the folly or cupidity of man has exhausted the animal and vegetable matters contained in the soil, nature does not alter her usual course to meet his wishes by a hasty and unnatural decomposition of the remainder: but art can compel the speedy application of those scanty remains, by the use of stimulating manures.

When a due proportion of the vegetation excited by these means is judiciously returned to the soil, it is vastly more speedily restored to its original fertility, than could have been effected by the joint efforts of nature and art, in any other way known to us, except by the introduction of extraneous enriching manures.

It should, however, be recollected that the nutriment arising from this hasty decomposition, is in this case profitably applied, and that in attempting to make farm yard manure a better food for plants, by the different modes that have hitherto been pursued, a very considerable proportion of its best nutritive properties is destroyed before it is used.

Some writers say, when fresh dung is applied to plants, that fermentation is not excited, and that it becomes a dryish wisp, incapable of affording nutriment for plants. Others say, fresh or hot dung (as they term it,) injures vegetation by an excess of heat. Both cannot be right, as they are directly opposed to each other.

I have been in the practice of planting Indian corn on grass lays, or corn mixed with other plants, and of cutting off the corn by the roots in the fall, and seeding the grounds with wheat.

My cattle yards and stalls were profusely littered with corn stalks, straw, leaves, &c.; of consequence, the manure for my corn crops consisted principally of these substances. They were ploughed under the soil early in the spring, but not without some difficulty, as it required the active exertions of a boy with a forked stick to clear the head of the plough. Still, when the grounds were cultivated for the wheat, those substances were so far decomposed, that but little, if any, traces of their original form appeared; even when my grounds were ploughed previously to the sowing of the wheat.

This practice has not been confined to soil or climate. The result has been the same in loams, stiff retentive clay, and on light sandy soil. Likewise in the climate where I now reside, which is

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much cooler throughout the summer, and much moister than where I formerly lived.

Dung well stored with litter is a good non-conductor of heat. It therefore greatly retards evaporation from the ground underneath it. It also absorbs much moisture, and while the ground above it is dryer than that underneath, the moisture is continually absorbed from the earth below, and diffused through the soil above. Thus in any soil or climate the ground is much moister during a dry time, where dung well stored with litter is used, than where decomposed dung has been applied: provided the cultivation be calculated to suffer the dung to remain undisturbed, and closely covered within the soil.

The destructive use of septic substances has been practised in every possible way. Great masses of mould were formerly incorporated by manual labour with lime, by frequently turning and mixing the contents. However, a considerable saving of labour has since been effected, by incorporating the lime with the mould by frequent ploughing and harrowing the mass; especially when the soil accumulated on the head lands is used for this purpose.

But as it is believed in either practice that the compost is not properly prepared, unless time is given between the mixings for the creation of certain enriching principles, that are supposed to be formed during the process, the animal and vegetable matters contained in the mould are very extensively destroyed by decomposition. The exposure to the air, sun, rains, &c. during the process, greatly favours the escape of gaseous effluvia arising therefrom. Were it not that the lime contained in the compost acts powerfully on the soil to which this compound is applied, much less benefit would arise from the application of it.

If such expensive mixtures are made, they should be applied immediately after they have been incorporated: or it would be a far better practice to haul and spread the mould first, and after the lime had been spread over it, to incorporate the whole by the tined harrow, with the surface of the cultivated soil underneath it. This would be done with much less labour, and the improvement would be equally great. In either case, but little or perhaps nothing is lost by the hasty decomposition of the animal and vegetable matters, as it is applied to the growth of the crops. Still, it should be remembered, that where there is animal and vegetable matter enough to promote a sufficient decomposition for the luxuriant growth of the first crop, that the hasty and unnatural decomposition of the overplus not only wastes, but also renders it far less useful to the round of crops, and the grasses following.

The soil will be less expanded, and the plants less excited, by the more feeble fermentation that will naturally arise, after this useless decomposition of too much of the animal and vegetable matters has been effected.

In common, however, a full grown crop of the grasses, or weeds, grown on the soil and ploughed under it, with the application of

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the lime alone, incorporated by the tined harrow, with the surface of the sod, after it has been reversed and properly prepared, will provide more nutriment for plants, than the lime and mould applied in any way; and will also save the very expensive labour of digging, hauling, and spreading the mould.

But so infatuated are many with laboriously compounded ingredients, or the quackery of farming, (namely, injudicious, expensive, and but too often destructive compounds,) that they tell us the mixing of lime with sand, forms a very valuable compost for grass grounds. It is evident, however, that inert sand furnishes no matters on which the lime can act profitably. The only advantage which can be derived from this labour is, that time, with the turning and mixing, cause the lime to become less caustic, and this may be equally as well obtained by suffering it to remain unapplied, until time alone has effected the same purpose.

By top dressing, much of the best properties of the putrescent manures are exhaled or wasted in the way that has been described. If to this be added the too general loss sustained by decomposition before the manure is applied, it will be found that but little good can be done by a great deal of it, when used in this way.

If dung be used for top dressing, it should be applied soon after the first crop of grass has been mown; and before the manure has suffered any material loss by fermentation. The grasses should be suffered to grow until they form a close shade. After this, they may be pastured; provided a good covering of them be preserved. This will prevent much exhalation; it will also keep the soil much more open to receive the juices of the manure. As water does not pass off so freely through a close pile of grass, much of the coarser particles of the washings from the manure, will be arrested in their progress through it, and much more of the juices from the dung will sink into the soil. The close covering also greatly favours the decomposition of the litter, and by keeping it flexible, causes it to sink further into the soil, and lie much closer to it. Therefore but little if any of it will be found in the way of mowing the ensuing crop of grass, or of making it into hay; provided the manure be very evenly spread over the ground. But as the want of the second crop for hay and other circumstances, may readily prevent the cultivator from hauling the dung at the proper time, he may haul and spread it any time before frost sets in; but not with the same advantage. Still, if care be taken in raking up the hay of the ensuing crop, but little of the litter will appear among it.

Top dressing, however, with putrescent manures, is, under the most favourable circumstances, a very wasteful practice, and should be avoided, where population is sufficient to admit the practice of convertible husbandry; except by those who prefer the ease obtained by grazing exclusively, to a more active and much more profitable mode of management.

When ashes, gypsum, lime, &c. are applied to the grass grounds, it must be by top dressing. But either of these substances is more

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extensively useful to cultivated crops, when they are properly incorporated with the soil.

It is difficult to calculate the losses arising from the prevailing practices of gathering, preparing and using the manure, that might be obtained from the general resources of a farm. Some manage better, and others worse. Neither weight nor measure to ascertain these losses can be referred to. We may, however, form a tolerable estimate of their amount, by summing up the supposed losses arising from each improper practice; and as well as it may be done, averaging the losses. This must centre between the best and worst practices in general use. I have done this, and believe the loss cannot be less than seven-eighths of the whole, which might be very readily saved by good management, and a proper cultivation.

Whether farmers consider it too troublesome to drive their cattle to and from water, during the season for feeding them on dry fodder, or erroneously suppose they are benefited by the exercise of strolling about the lanes and highways, or are governed by custom, and pay no attention to the subject, is unknown to me. Such is, however, the too general practice, and if the days were as long as the nights, and the cattle turned out early, a great many farmers would lose half their manure by this inconsiderate practice alone.

I have heard of cattle yards calculated to save the manure: but although I am now advanced on the wrong side of sixty, I can truly say that I do not recollect to have ever seen but one cattle yard, that did not admit the washing rains and melting snows to pass through them, so as to sweep away the riches of the manure, unless perchance they happened to be placed on some spot, which naturally turned off the water coming from the adjacent grounds. From this a great loss must occur; especially as I have often seen, that the farmer, to keep himself and his cattle from being mired in the cattle yard, had cut drains to let off the offending matter; although his cornstalks, and very often his corn fodder too, were suffered to stand and dry rot in his fields, and much straw was also seen lying about his barn.

Nothing can be more simple or cheap than the proper construction of a cattle yard. Some are made concave with great labour and expense. These save the manure, but must be too wet to be healthy or comfortable. A flat is not desirable; but when unavoidable, may be kept dry with some labour and contrivance. A declivity is best, with a small drain dug round the outside of the fence; and the earth from it formed into a bank under the bottom rail, high enough to exclude the water from without. A wide hole, formed somewhat like a ditch, should be made on the outside of the fence, at the lowest end or side of the yard, to receive the drainings from the manure, taking care to prevent the water from the outside of the yard from running into it. In this, spread a layer of earth that has been broken to pieces tolerably fine by digging, pitching, &c. to imbibe the washings carried off from the yard, by the rains

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and melting snows which fall into it. When this becomes fully saturated, add another layer, proceeding in this way until you wish to remove the manure. The earth digged from the ditch may be used for this purpose while it lasts. After it has been expended, any earth, except sand, or a compact clay, (if free from stones,) that may happen either to lie in your way, or can be got with the least expense, may be used for the same purpose. For, as it has been observed before, it is not the earth, but the animal and vegetable matter contained in it, that enriches the soil. Therefore if you have any mould that will pay for hauling, digging and spreading, it will be far better to haul it immediately to your fields than to haul it twice; particularly as a poor or inert earth is capable of imbibing much more of the animal and vegetable matter from the washings, than one that is already well stored with the same materials.

If liquid manure be preferred, dig a hole in the form of a well to receive the drainings from the yard. This should be kept covered, to prevent evaporation and accidents. I believe that time, with the materials running into it, will puddle the bottom and sides, so as to make it nearly if not quite water tight. This happened in a sink digged through a loose clay into a stratum of sand, to run off the water from my pump and kitchen. If the matters filling up the pores of the sand were not occasionally scraped off, the water would rise up and run over the top of it. We also see that hollows, even in sandy grounds, are puddled and made water tight by the materials washed into them. The pump, spouts, casks, &c. necessary to the removal of liquid manure, with the difficulty of spreading it regularly, seemed to introduce expense, complication, and perplexity; therefore the ditch and earth were used by me. Some loss unavoidably arises from evaporation, but not so great as at first sight appears. The juices from the manure are generally heavier than the rain water that conveys them into the ditch: this causes much of them to sink under it, and when the water has evaporated, they should be covered with a light layer of earth.

Paving and various methods have been proposed to make the bottom of cattle yards impervious to the juices of the manure. No contrivance, however, except a costly cement under the pavement appears likely to be effectual, and even this is doubtful; but if it were not, the expense does not seem to accord with the proper economy of farming. Therefore, the native earth may be justly considered the most profitable bottom that is yet known to us. When the dung is removed, the yard may be scraped so far down, as a sufficiency of the juices have penetrated to make the earth a valuable manure. After this, if the natural form of the ground require alteration, the hollows may be filled up by the heights every spring, so far as leisure may permit, until the bottom of the yard is reduced to the best form the situation will admit.

After the annual scrapings have made the bottom of the yard too low, it should be well filled up, with any kind of earth free from

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stones, sand and a compact clay excepted,) that will cost the least labour. This ought to be done soon after the dung is removed in the spring, that the bottom may become hard before the winter feeding commences. Sand is too loose to imbibe the juices from the dung, for they pass too freely through it, and compact clay is too impervious to be readily enriched by them.

Some suppose that great advantages are derived by well covering the cattle yard annually with mould, marl, &c. Such a covering does not, in the course of one year, imbibe enough of the juices to pay for the double digging, hauling, and spreading of it. It also keeps the yard too wet, and is incapable of absorbing nearly all the juices that are swept off by heavy rains and melting snows. At all other times, the open texture of the straw, cornstalks, and other vegetable substances used for litter, calculates them, in proportion to their weight to imbibe much more of the juices than the earth, and certainly they are in themselves much more enriching.

If the earth be considered useful, either as a mechanical or enriching manure, much useless and injurious labour would be saved by hauling and spreading it at once on the fields.

The richer dung from the stables and sheds should be wheeled and spread over the longer and poorer manure in the yard. This, with frequently littering the yard, together with the treading of the cattle, will mix the whole together, without the extra expense of turning, mixing, and heaping it: provided the cultivator sees that the business is properly conducted. But little loss will arise from fermentation, when compared with that which will take place, even through the winter, when the rich manure is piled up in heaps. The extensive body and richness of it greatly favours fermentation.

As it is far better, under any system of management, for the cattle to run at large in the yard, through the day, unless the weather be bad, moveable hay-savers for holding the hay, corn fodder, &c. should be constructed, that the rich droppings from the cattle may be regularly spread over the yard; unless they be fed under open sheds, and are never confined. The formation of these savers are simple, and will be explained, and also the cheapest and best method of sheltering cattle through the winter.

The farm yard manure that is left or gathered after the early fallow crops have been planted, may be preserved from any very material waste, by heaping it on a layer of earth sufficiently thick to absorb the drainings from it, and covering the heap with as much mould as will imbibe the principal part of the gaseous effluvia arising from the manure. A thick covering of pure compact clay will prevent any loss from evaporation; but such a covering will imbibe so little of the matter from the dung, that it would be of little or no use for manure.

If the dung must be kept throughout the summer, a thick coat of thatch over the covering of mould will greatly retard fermentation; for straw is a good non-conducter of heat. It would also prevent the escape of the volatile matter from the manure, and the covering of

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mould would be much better saturated with it. If the st[illegible]be used for litter, nothing will be lost that can be readily saved. Any loose straw, if put on sufficiently thick, will do equally as well as a regular thatch; nay, much better, for it will cost much less labour. He is the best farmer who grows the best crops, and most extensively improves his soil, with the least possible labour and expense.

Since it has become fashionable for gentlemen possessing immense estates to farm, the farming world seems to have been so intent on what has been considered improvement that they appear to have forgotten, (especially in England,) that one of the most valuable improvements, which can be made in agriculture, is to simplify it, so that every thing may be done with the least possible labour or expense, that is consistent with a good cultivation, and the improvement of the soil.

The Farmer's Journal, published in London, clearly and very pathetically delineates the very distressing situation in which the agriculturists of that country are involved; but one of the principal causes of this distress seems to have been overlooked. The increase of the taxes is loudly complained of, and not without cause; but it would appear that the tithe is now considered an insupportable burden. It is true that this tax has been always deservedly unpopular; still it has not, until of late, been considered an intolerable burden. On the contrary, it has been, for a very great while, paid without any very apparent injury to agriculture. However, in the whole of the complaints, which have been made, in almost every shape and form, against taxation, it seems to have been entirely forgotten, that agriculture may tax itself, as highly as any government possessing common prudence dare venture; especially, in a country where the people may not only complain, but must and will be eventually heard. But as this very interesting subject is more particularly connected with gentlemen farming and cultivation, I refer the reader to my books on these subjects, for an explanation of the expensive practices, as well as the very injurious alterations, which have been too generally made in the size of the farms, and also in the farmers, as is clearly seen by the practice of too many of those, by whom the soil is now extensively cultivated.

Here, however, I would ask, whether it be possible that the agriculture of any country can permanently flourish, where a middle grade of gentry have been created, to stand between the owners and the cultivators of the soil, who must be nearly as extravagantly fed and clothed, and their children as politely educated, as the proprietors of the land, although neither of them labour on it? Certainly not, for the cultivators of the soil in every country ought to be a hardy, active, laborious, intelligent, and economical race of men. And the owners of it ought to set the example of the best modes of cultivation and management, accomplished with the least possible labour and expense.

Agriculture is greatly indebted to Sir Humphrey Davy. For

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although his experiments on farm yard manure determine nothing more, than our eyes and nose might have long since done, still his great chemical talents will powerfully enforce a more rational use of this highly important article.

However, as things which he has recommended respecting it, do not appear to accord with nature and reason, harmonized in the practice of husbandry, they should be controverted; especially as Sir H. quotes the celebrated A. Young to show, that practice accords with his theory; and Judge Peters says, that "Mr. Young's dung is not the straw and unfermented mass, applied by hot and fresh muck farmers."*

If my memory be correct, Mr. Young formerly considered the dung under his sheds, which was in a high state of fermentation, much better than that in his yard which had not fermented. If so, his candour in the present instance is worthy of imitation. In a lecture read some time ago before the British Board of Agriculture, he asserts, that "were the practice of using fresh dung general, it would add above twenty millions sterling to the produce of the kingdom."

Among other proofs to support this assertion, he introduces the practice of Mr. Ducket, a very intelligent but plain practical farmer; and in doing this, says, "Dependent on the trench plough, is Mr. Ducket's system of dunging; he conceives, and I apprehend very justly, that the more dunghills are stirred, and turned over, and rotted, the more of their virtue is lost. It is not a question of straw merely wetted, but good long dung. Without the trench ploughing, however, his opinion would be different."†

Trench ploughing is certainly by far the best practice where the soil is rich and deep, or manure is very plentifully applied. When, however, the soil is thin, and manure scanty, trench ploughing is very injurious, both to the crop and the soil, as will be hereafter explained.

But as little trench ploughing is done in this country, practice determines that fresh, long dung well turned under, from five to six inches deep, is equally efficacious in proportion to the soil, depth of ploughing, and manure; provided the crop be properly cultivated.

There is no standard to determine exactly what good fresh long dung is: but as Mr. Ducket is a good farmer, there can be no doubt but, like every other farmer of the same description, he carefully gathers and uses all the litter his farm will afford: therefore, his long fresh manure must be much the same as has been recommended by those whom Mr. Peters calls "hot and fresh muck farmers." But what he means by "the straw and unfermented *mass*" applied by "hot and fresh muck farmers," is certainly beyond my comprehension.

If the word "*mass*" be meant to include more straw or other litter than is commonly used on a well ordered farm, they would be more

* See Mem. Philad. Agr. Soc. vol. iii. page 414. † Ibid, page 414, 415.

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justly termed "cold and fresh muck farmers." If this word be intended to include dung from the cattle in the quantities generally used by those whom he calls "hot and fresh muck farmers," the manure would be much the same as that used by Mr. Ducket, or any other good farmer, who applies his dung before it has been wasted by fermentation. However, leaving this enigma to be better explained by the President, I will proceed.

Sir H. Davy says, "a light incipient fermentation is undoubtedly of use in the dunghill, for by means of it a disposition is brought on in the woody fibre to decay and dissolve when it is ploughed under the soil."*

I have before shown, that practice and observation clearly determine, that nature is not deficient in the processes of fermentation and decomposition; and Sir Humphrey says himself, "When straw is made to ferment, it becomes a more manageable manure, but there is likewise, on the whole, a great loss of nutritive matter. More manure is perhaps applied, for a single crop; but the land is less improved than it would be, supposing the whole vegetable matter could be finely divided and mixed with the soil.

"It is usual to carry straw, that cannot be employed, to the dunghill to ferment and decompose; but it is worth experiment, whether it may not be more economically applied when chopped small and kept dry till it is ploughed in for the use of the crop."†

Now if so much labour is to be expended to save the nutriment contained in dry straw, why is the dung to be wasted by fermentation to dispose the woody fibre or litter mixed with it to decay and dissolve? especially as a powerful disposition to fermentation is obtained by these substances being well saturated with the rich juices of dung.

Sir H. Davy's Lectures on Agricultural Chemistry is a valuable book; and every farmer who reads ought to have it. But he should not follow it, or any other book, (including mine among the rest,) further than the author follows nature and reason. It may be laid down as a maxim in farming, that no practice can be good that is opposed to either. We may all see that favourite systems have such a powerful influence on the mind of man, that they too often cloud his understanding, and reason imperceptibly bends, and becomes subservient to them.

This gentleman says, "when farm yard dung cannot be immediately applied to crops, the surface should be defended as much as possible. A compact marl or tenacious clay offers the best protection against the air, and before the dung is covered, it should be

* See his Lec. on Agr. Chem. page 302.

† See his Lec on Agr Chem. page 284. But here I would ask Sir H. by what newly invented machine, a sufficiency of dry straw chopped small, could be ploughed under the soil, to be of any material use to agriculture. Also, whether he can seriously believe that any profits to be derived from farming, would pay for chopping straw small, keeping it dry, and using it in this state for manure.

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dried as much as possible." "If the dung is found at any time to heat strongly, it should be turned over and cooled by exposure to the air."* "It should be defended from the sun. To preserve it under sheds would be of great use, or to make the site of a dung-hill on the north side of a wall; the floor on which the dung is heaped should, if possible, be paved with flat stones, and there should be a little inclination from each side toward the centre, in which there should be drains, connected with a small well, furnished with a pump, by which any fluid matter may be collected for the use of the land."†

A shaded situation is unquestionably best; and if the dung can be well covered under vacant sheds, the practice may be good. But to build sheds for storing dung, or pave bottoms, dig wells, and form cement for the bottoms and sides of them, in the usual way, and make pumps, &c. is entirely inconsistent with the economy of farming. No profit derived from it will remunerate the expense; especially as the dung may be quite as well, and perhaps better saved, in the simple manner that has been before pointed out. If gentlemen wish to instruct the common farmer, they should commence by introducing the utmost possible economy in every department of agriculture. If this be done, it will soon be found that the common farmer, (at least in this country,) is capable of exercising his reason, (and that judiciously too,) on subjects with which his interest is connected. It is the enormous and useless expense that is but too generally attached to gentlemen farming, which causes common farmers to reject what gentlemen propose. These men are not, as too many suppose, divested of understanding; on the contrary, they show their good sense by not giving into practices that would infallibly ruin them, unless they had become so wealthy as not to be seriously affected by adopting them: but to proceed.

Drying the dung as much as possible before it is heaped, must cause much of the rich volatile matter to escape, and cost a good deal of labour. Opening and turning the dung over every time it heats strongly, is a very expensive and destructive business; and well calculated to scatter its best properties in the air. Notwithstanding, some gentlemen say that in drying dung nothing but the water escapes, the fœtid smell of the gaseous effluvia arising from it determines the contrary.

Farmers might make a valuable addition to their farm yard manure, by digging a hole at a convenient distance from their kitchen, about three or four feet deep, and sufficiently wide to form a common receptacle for the various matters originating in and about the house, extending a paved gutter from the kitchen to it, to conduct soap suds and other useless slops into it. When it becomes offensive, the offending matter should be covered with earth. That which was thrown up in digging the hole may be applied so long as it lasts.

* See his Lec. on Agr. Chem. page 306. † Idem, page 307.

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Care should be taken to prevent the water from without from running into it. The receptacle may be hid from sight by planting an evergreen hedge around it, leaving an opening at the back for putting in and taking out the contents.

The necessary may be placed by the side of the receptacle; and every thing from it readily conveyed among the rest of the compost; provided the farmer is willing to convey the disagreeable but very valuable contents to his fields, and plough them under the soil; or can hire others to do this for him.

The effects produced by this very powerful compost, will be seen by his neighbours, and others may follow his laudable example, until the beneficial practice of using night soil for manure, be brought into as general use as it has been in other countries, where habit has rendered the use of this article familiar.

If the yards be duly swept, and the valuable contents be put into the receptacle, the health of the family will be promoted, and visiters will not be annoyed by the stench arising from privies, and stagnant gutters, too seldom, if ever, cleaned out.

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CHAPTER IX.

Manures not in general use pointed out. Vegetable substances should not be reduced to ashes when manure is the only object, and the substances can be applied without being burned. The best mode of applying lime when substances to be decomposed are ploughed under the soil. Sir H. Davy's theory of the indecomposable property of woody fibre considered; also, what he and Mr. Young say of tanners' waste bark. The effects of water on vegetation. Practical observation seems to determine, that with proper management the soil may be greatly enriched, by the depositions from the atmosphere. On the interesting economy of the kidney bean, &c. How gypsum acts when seeds have been rolled in it previously to their being sown.

As some manures which are not in general use will be found very profitable, where they can be readily procured on moderate terms, I will point them out, and make some observations on them.

There is no part of an animal which does not furnish valuable manure. The parts that quickly decay are not so lasting, but more powerful.

Bones, when reduced under a stone, similar to those used for grinding tanners' bark, are, when broken into pieces, not exceeding a small chesnut in size, an excellent and very lasting manure. Fifty or sixty bushels are applied to the acre. Much less would suffice if they were broken before the grease is boiled out of them for other purposes. Or if they were much finer ground, a great deal less would produce the same immediate effect.

Horn shavings and turnings are still more powerful than bones which have been stripped of decomposable animal matter. Twenty bushels per acre of them, are commonly applied.

Sheep trotters are said to be very valuable, and applied at the rate of forty bushels per acre.

Damaged wool, and the offal trimming from sheep, are also used for manure, from ten to twenty hundred weight to the acre, in proportion as the quality may be more or less valuable.

Woollen rags, cut into small pieces in a paper mill, have been very successfully used at the rate of from fifteen to twenty hundred weight to the acre.

Fish are sometimes caught in large quantities for manure. Twenty bushels to the acre have been used very successfully. Salted fish, after being damaged, have been also very profitably employed for this purpose. So has the brine from sound fish.

Feathers are a valuable manure; when damaged in quantities, they may be profitably applied to this purpose. The farmer should have the feathers that are not used for more profitable purposes, put into his receptacle. Also, the hair scalded from his hogs, &c. This,

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or hair taken from skins by tanners is valuable. The blood from animals that are killed on the farm, should also be put into the receptacle, for it is a very rich manure.

Furriers' clippings and curriers' shavings are valuable manure; thirty bushels to the acre. The offals from the tan-yard and glue maker are also equally valuable.

It seems probable that the clippings and chippings from shoe makers, saddlers, and others working in tanned leather would be valuable manure; but might require some decomposition previously to being ploughed under the soil.

The scum from the boilers of sugar bakers, consists of bullock's blood, and saccharine matter, consequently is a very rich manure.

Fresh oyster or clam shells, when broken into pieces are a very valuable manure; they would, however, be much more useful and powerful, if they were finely powdered.

Where any kind of shellfish is plenty, and may be readily procured, they will be found very valuable manure, if broken into pieces previous to their being ploughed under the soil.

It is said that the corals, coralines and sponges, contain equal parts of decomposable animal matter and lime; therefore, where they can be readily obtained, they may be advantageously used for manure.

Spoiled salted beef, pork, &c. may be formed into a compost with earth. When the latter has imbibed the principal part of the decomposable animal matter, the compost may be removed with as little or less offence than slaughterhouse dung. The brine of sound beef, pork, &c. is also valuable manure.*

When domesticated animals die, it is the common practice to let them rot above the ground. This is sure to annoy the neighbourhood. If the stench from the animal be too distant to contaminate the air, dogs are fond of carrion, and after they have gorged themselves with it, become insufferable inmates to the families to which they belong. The dead animal should be laid on a thick layer of earth, and well covered with the same material. After the covering has sunk in, and the earth has absorbed the animal matter, the compost will not be more offensive than slaughterhouse dung, provided a sufficiency of earth has been employed. If such offensive manures be removed regularly, before the season renders them very noxious, the injurious prejudice against working among them will cease. They should be hauled to the field during winter, and ploughed under so soon as frost will permit. The same should also be done when night soil is used.

Urine is a very valuable manure, and may be readily saved on farms by putting it into the common receptacle.

* The product of wheat has been considerably increased by soaking the seed in fish brine, and rolling it previously to sowing, in dry unleached ashes. The same effect is to be expected from the brine from meat, in proportion to the animal matter contained in it. Brine made of salt, and used in the same way, has been also found to increase the crops of small grain and prevent smut.

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The manure from privies is very powerful. It is said that five loads to the acre have restored exhausted soils; and that two loads per acre, annually applied, has excited and maintained luxuriant vegetation. The interest of agriculture would be greatly promoted by contriving cheap and simple means of saving the manure in cities, villages, and on farms, and of conveying it to the soil with the least possible offence. Quick lime, or other septic substances, should not be employed to effect the ready removal of it.

Sir H. Davy says, "The Chinese, who have more practical knowledge of the use and application of manures, than any other people, mix their night soil with one-third of its weight of a fat marl, make it into cakes, and dry it by exposure to the sun. Those cakes, we are informed by the French Missionaries, have no disagreeable smell, and form a common article of commerce in the empire." "The earth, by its absorbent powers, probably prevents to a certain extent, the action of the moisture on the dung, and likewise defends it from the effects of air."*

The experiment seems to be well worth trial; especially as there appears to be but little, if any difficulty in getting the busines done. It offers an additional profit to those who clean out necessaries, to be obtained with quite as little, or perhaps less exposure to offence.

How the Chinese save their night soil is unknown to me. If as much moisture be mixed with it as obtains in our privies, much more marl must be used by them.

A pure compact clay will be found better for this purpose than a calcareous marl,† as the latter decomposes animal and vegetable matters.

The agricultural societies organized in our cities, might have this experiment made with but little trouble or expense. To prevent error, some active intelligent member should, in the beginning, superintend the process.

Pigeon dung is a very powerful manure; so is that from farm yard poultry. However, neither the dung nor the fowl will ever pay the farmer one-tenth part of the money they cost him, if he suffers them to pillage his fields and mow in the usual way. They should be confined when damage may be expected from them in the fields, and the grain in the mows should be kept closely covered with straw.

If this, however, be done, and the poultry are not taught to roost regularly in houses provided for them, but little manure will be gathered. Such houses cost but little, if utility in place of parade governs the practice of the cultivator.‡

In some places, much valuable manure may be gathered where wild birds roost at night.

* See his Lec. on Agr. Chem. page 296.

† Clay without any calcareous matter in it, is sometimes improperly called marl.

‡ In England, what is called a complete establishment for poultry, often costs more money than a valuable farm would cost in many parts of this country.

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Street dirt is an assemblage of substances; some of which are mechanical, others enriching, and some stimulating. When too large a proportion of the first does not prevail, it is a very valuable manure.

Sea, river, and pond weeds, from fifteen to twenty loads to the acre, have been used with success.

The weeds growing in our fields may be very profitably used, provided they be ploughed under the soil not less than five inches deep, and a cultivation calculated to keep them there be pursued.

When potatoes, or any other root which can only be gathered by turning up the soil, is planted, the use of weeds should be avoided, unless the soil be sufficiently deep to admit the practice of trench ploughing.

Straw, and some other vegetable substances, may be ploughed under the soil in tolerable quantities when very wet: but as it is difficult under any other circumstances than a partial decomposition, to plough under a sufficiency of this weak manure, to do any very material good to the crops, it is much better to lose some part of it by fermentation, than to injure the round of crops, and grasses following them. Cornstalks, and other bodies equally hard, will require more decomposition than straw, before they can be readily ploughed under the soil in sufficient quantities to answer any very valuable purpose. Where cattle are plenty, every vegetable substance that can be profitably used for litter, should be applied to that purpose, as the rich juices in the cattle yard will increase their value many fold.

Leaves, when raked up through the woods, in the fall and winter, and suffered to remain under the shade of the trees until a great heat takes place in them, become very compact; and but very partially decomposed. In this state, they may be ploughed under the soil, and are a valuable manure.

If the ground, however, be annually raked, the grasses will grow, the soil will become hard, and the timber be eventually destroyed, as are the trees in our orchards, when the grasses are suffered to take possession of the grounds. Therefore the woods should be laid out so, that one-third part of them only be raked in the course of three years. By this means, the grasses will be kept under, and nature will keep the soil open and mellow for the roots of the trees, by the fermentation of the leaves, and other substances covered by them. The loss of the leaves from this practice will not be any thing like so great as at first sight appears; for the economy of nature is perfect: consequently, the fall of the leaves of the last year is preserved by her, to form a compact covering over those that had fallen before. This not only prevents the growth of the grasses, but also much evaporation from the fermentation of the animal and vegetable matters underneath them.

It has been confidently asserted, that stone coal is an excellent manure; that it has succeeded both in Europe and this country:

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therefore, I am disposed to believe, under favourable circumstances, it may be so.

I have tried it here by top dressing, without any perceptible effect, on corn, wheat, red clover, and the spear grasses, although the coal was pounded quite fine, and sifted. This may have happened in consequence of the soil being impregnated with some of the properties of the coal, as it frequently appears near the surface throughout the whole neighbourhood; or it might have succeeded, if it had been ploughed under the soil. There is also a great difference in coal; that used by me abounded in sulphur and bitumen, and burned freely.

The ashes from stone coal have been extensively used for manure at from forty to fifty bushels to the acre. So has soot from the same substance, at from twenty-five to forty bushels to the acre; likewise the ashes and soot from wood. Too little care is taken of soot in this country. The farmer may have that from his own chimneys put into the receptacle.

Little is practically known of peat in this country; but the ashes from it are much used in England for manure. Burning is, however, a destructive practice, and should be avoided whenever it can be done. It is much better to expose the peat to the influence of the atmosphere, until it can be ploughed under the soil.

The great value of chip manure from our wood yards, when it is but very partially decomposed, should teach us the great impropriety of reducing vegetable substances to ashes, when manure is the only object, and when they may be applied without burning. If these chips were reduced by fire, previously to their being applied, the comparative value of them would be trivial indeed. The cause of this is evident: when they are ploughed under the soil, and a cultivation calculated to keep them there is pursued, fermentation and decomposition are promoted, and gradually spread all their exciting and enriching influence through the grounds, with the least possible loss; and ashes stimulate, but do not enrich the soil.

Sir H. Davy says, "Peat earth, of certain consistence and composition, is an excellent manure, but there are some varieties of peat, which contain so large a quantity of ferruginous matter, as to be absolutely poisonous to plants."*

This can only happen when the peat is applied in too large quantities; as Sir H. and many other gentlemen have shown, that ferruginous matter is an excellent manure. It is true, that he rather seems disposed to confine the usefulness of it to calcareous soils; in which, he says, it unites with the lime, and gypsum is formed.

Agreeably to this theory, the peats which contain large quantities of ferruginous matter, may be rendered very valuable manure, by mixing them with fresh slaked lime, previously to their being applied: but as economy is important in the practice of farming it

* See his Lec. on Agr. Chem. page 6.

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would be far better to spread the lime first over the lay, and after this spread the peat, and turn the whole under. This will place the lime on and among the peat. If the ground be ploughed a little deeper when the next round of crops takes place, the lime will be brought to the surface of the soil. This practice would be beneficial when peat of any sort, or hard vegetable sustances of any kind, are applied for manure.

Sir H. says, "Inert peaty matter is a substance of the same kind, (alluding to tanners' spent bark.) It will remain for years exposed to water and air, without undergoing change, and in this state yields little or no nourishment for plants."* Dr. Darwin recommends heaping peat either with or without lime, in order to expedite the decomposition of it.

This, with other accounts we have of the properties of this vegetation, induces me to believe, that Sir H. may be as mistaken about peat, as he evidently is, respecting woody fibre; which, he says, "will not ferment, unless some substance be mixed with it, which acts the same part as mucilage, sugar, and extractive or albuminous matters, with which it is usually associated in herbs and succulent vegetables."† Beside the exciting causes here briefly enumerated by this gentleman, there are others which have been mentioned by him:‡ some of these may not exist in some trees, and but little of them in others. Still, there is in every tree a sufficiency to predispose the wood to fermentation, when it is placed in situations favouring the process. The simple post, mentioned before, determines this;§ so does the decomposition of the chips in our wood yards, but more especially the innumerable trees that time, tornadoes, &c. have prostrated in our forests.

Here we see, without being misled by erroneous theories, the processes of fermentation and decomposition, in all their different stages, as well as on the different plants which may claim our attention: but as woody fibre is the subject now under consideration, and the decomposition of it has been described, nothing more is necessary to be added, than that some woods rot very rapidly, others, more slowly, and some, either from a deficiency of those principles which favour fermentation, or other causes, decay so slowly, that they are like charcoal, improperly termed by some indestructible. However, the most durable woods are decomposed by time; and a shaded situation, where rain has access, greatly promotes the process.

This is best seen in the back-woods, where various causes induce the settlers to abandon a clearing soon after it has been commenced. In that case, the brush heaps sink soonest into decay.

* See his Lec. on Agr. Chem. page 285.

† Ibid. Here Sir H. seems to insinuate, that these matters are confined to herbs and succulent vegetables; than which nothing can be more erroneous.

‡ Idem, page 73.

§ It should be recollected, that posts are commonly formed of the most durable and well seasoned wood the farmer can readily get.

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The heaps of logs, from their compact form, and being kept continually more or less damp, by rain and shade, rot much sooner than many would readily imagine, unless they happen to be formed of very durable wood.

If the philosopher, who wishes to study nature, would, in place of making a tour of Europe, where art has nearly obliterated her features, spend half the time and money in the interior of the United States, where the line of cultivation separates pure nature from art, he would not only see nature as she is, but by comparing her perfect system of economy with what art had done in the older settlements of Europe, and what it was now doing in America, more especially in the vicinity of the wilds where nature presides, he would be far better prepared to write on any subject connected with her economy in the different processes on which vegetation depends.

As all our ideas arise, either directly or indirectly, from our senses, the more we are exercised on the subjects we wish to understand, the better we shall become acquainted with them.

An expert and intelligent artist, who has never seen nature as she really is, may draw an interesting likeness of her. It, however, vanishes when the original appears.

It is said that tanners' waste bark, when completely putrefied, affords an excellent manure; and that one load of it is equal to two of dung. This seems to be rating it highly; however, it may imbibe some animal matter from the hides. If so, it appears that it should be much sooner used, especially as the vegetable matter must also suffer considerable loss by lying so long.

It is also said, that if this manure be intended for grass, it ought to be spread in the latter part of September, that the winter's rains may wash it into the grounds; for if applied in the spring it will burn the grass. But if applied for wheat, it should be spread immediately before the last ploughing, to come in contact with the early roots of the plants.* It would, however, seem that but little is practically known of it. Mr. Young says, "spent bark seemed rather to injure vegetation;"† he attributes this to the astringent matter that it contains. Sir H. Davy says, "it is freed from soluble substances in the tan pit; and if injurious to vegetation, the effect is probably owing to its agency upon water, or mechanical effects;" and that it is "an inert substance, and remains for years exposed to water and air without undergoing changes."‡

These opposing opinions furnish one of the numberless instances in which gentlemen, whose talents are highly and justly esteemed, advance opposite theories; and clearly determine that nature and reason should be consulted by the farmer, before any practice be

* It would appear much more likely to injure the tender roots of the wheat. Practice, however, in the back-woods, clearly determines that it will injure neither, unless the quantity be too great.

† See Sir H. Davy's Lec. on Agr. Chem. page 285. ‡ Ibid.

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admitted or condemned by him. More especially as neither of those gentlemen is right.

As far the greater part of the astringent matter contained in the bark is expended in the tan pit, that principle cannot injure vegetation, unless too great a quantity of spent bark be applied.

Where tanning is judiciously conducted, and bark sells high, all the astringent matter that can be profitably used is extracted. Still, when that matter becomes too inconsiderable to pay the expense of attending the further use of it, the process ceases, and leaves the remainder in the water and in the bark.

As the principles which promote fermentation have been extracted to a considerable extent in the pit, tanners' spent bark cannot ferment so freely as bark from which none of those principles have been extracted, unless the animal matter imbibed from the hides may make up this deficiency; which seems to be a doubtful question. Therefore, where lime can be had on moderate terms, it may be brought much sooner into active use, by the application of lime in the way that has been recommended for using it with peat.

Sometime after trees are girdled, the bark begins to fall and the process goes on gradually. That from the bodies or trunks, which constitutes a considerable part of the whole, generally rests in the forks formed by the roots. Where bad cultivation prevails considerable quantities of it are often covered with the soil. In this state it appears to decompose freely; but if the quantity happen to be too considerable, vegetation languishes and looks sallow. The same, however, occurs, where any other vegetation that is but partially decayed, accumulates in excess.

It seems to be worth trying whether the liquid from the tan pits would not promote vegetation, after it was no longer useful for tanning.

But few rabbits are kept in this country. However, as their dung is very valuable, it should be saved.

Rape cake is also highly esteemed, and has been very successfully used for manure in England.

Linseed cake is said to be an excellent manure, but unless it has been damaged it is generally too costly to be applied to that purpose.

Malt dust is also said to be a good manure.

In fact the offals of almost every mechanical employment furnish materials for valuable manure. Even shavings, sawdust, and the chips and turnings from those working in wood. Therefore, it would be very tedious to enumerate the whole of them. Enough has been said to show that many manures, scarcely ever used in this country, are exceedingly valuable, and that much more attention should be given to them.

That water is a powerful promoter of vegetation is every where seen; but until I removed to this elevated situation, I had not so clearly seen the immense powers contained in simple rain water to effect that purpose.

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The passing clouds more frequently water the soil; consequently grass abounds much more than in the same latitude where the grounds lie much lower.

Our summers are much cooler and shorter than in the same line of latitude below us. Yet Indian corn, when planted in time, and properly cultivated, seems to be equally productive. To that crop moisture appears to compensate for a deficiency in heat. Other spring crops, on equal soils, appear to excel those below us. The same may be said of potatoes and turnips. I have grown the latter here without manure, and on rough grounds, not well cultivated, that weighed eight pounds.

Water is an important agent in promoting the fermentation and decomposition of animal and vegetable substances; and its fluidity is well calculated to convey the nutriment arising therefrom to the roots of the plants. It also constitutes a considerable portion of the bodies of plants, and as it has been before observed, is capable of dissolving most natural bodies, and also of imbibing and conveying their properties. Water parts with some substances previously to its descent in rain. Still, there is great reason to believe that it either retains, or gathers in its descent, enriching as well as fertilizing principles; as it soon becomes putrid in vessels which do not appear to communicate any of the causes of putridity to it.

Notwithstanding the numerous advantages derived from water, a superabundance of it, joined with a deficiency of heat, retards fermentation, and vegetation languishes and looks sallow, unless proper division has been made to carry off the excess. These effects are most pre-eminently seen in grain fields, especially in those of wheat sown in the fall where proper water furrowing has not been introduced.

The growth of the grasses is also considerably retarded from the same cause, but they are seldom very materially injured in this way, unless where the water becomes stagnant. If this occur, and very warm weather succeed, even grass may be greatly injured, and is sometimes ruined by a superabundance of putrefaction. If this be kept up by permanent spouts or springs, no valuable vegetation can exist; except near to the head or fountain of the springs, where it is generally luxuriant, and will often continue to grow through the winter, when vegetation is every where else completely locked up by the frost. It seems that the water passes of too soon near the spring to acquire sufficient putridity to injure the grasses.

This should teach the farmer the great impropriety of cultivating wet grounds, until he has properly drained them, unless ridging and water furrowing them in the way that will be hereafter described will answer the same purpose.

However, where the grounds are free from spouts or springs, this supposed excess of moisture, which cultivators who farm in every clime and soil alike consider a great disadvantage, may with proper management be turned to certain profit. It is not very difficult to make provision to run off an excess of water from

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rain; but where enough of it is wanting, it cannot be introduced in sufficient quantities for agricultural purposes, but by an expense entirely inconsistent with the economy of farming.

Hence it is that the grasses, and cultivated crops, in climates subjected to what is too generally considered a superabundance of moisture, are, when properly ordered, green and luxuriant, while those growing on lands which are much more highly esteemed are parched with drought.

Farmers who have exercised too little observation, and of consequence, as was before observed, farm in every clime alike, say, those dripping climates are excellent for grass, but very unfit for grain. It may, however, be laid down as a maxim in farming, that where real good grasses abound, grain will also abound, if a proper system of husbandry be pursued.

England is a northerly and moist climate. Still, grain prospers there, and would prosper as well, perhaps better, in Ireland, if as good a cultivation prevailed.

But it should be recollected, that the well instructed British agriculturist does not expect good crops of grain from an exhausted soil, unless it has been previously well manured, and if the soil requires it, laid dry; not only by proper water furrowing, but by laborious draining also, if that should be considered necessary.

It is generally believed that the atmosphere is laden with substances which greatly promote vegetation, and also enrich the soil; particularly when the latter is well covered with plants calculated to gather and shield those depositions from the improper action of the sun and air. Still, the great importance of gathering and securing them is not sufficiently appreciated; or a cultivation and management immediately opposed to it would not so generally prevail.

Their value is demonstrable, if it be granted, that all the improvement made in any soil with its own produce alone, must proceed from the enriching and fertilizing principles derived from the atmosphere; especially if the grain and roots grown on the farm be principally sold, and the principal dependence for enriching it, rest on feeding the hay and other fodder to cattle on the place, and using the straw and offal vegetation for litter.

Under circumstances though not exactly alike, but in substance the same, an improvement of nearly fourfold was made, in the course of five years, on a farm with which I was, at the time this was doing, intimately acquainted, and witnessed the progress of the improvement. It was determined, by estimating the value of the different crops; and the soil appeared to me to be fully as much, if not more, improved, during this time, than the crops had been. Some extraneous assistance was had recourse to; but more manure remained on the farm unapplied when this estimate was made than equalled the value of the foreign aid introduced by the cultivator.

The farm contained about one hundred and six acres of ground, of which about fifteen acres were thinly set woodland. The leaves

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from the woods were generally, but not always, used for litter. However, the loss to the soil from the sale of nearly all the grain and roots, must have very greatly exceeded the advantage derived from the leaves, although their value was not deemed inconsiderable. Now if this improvement did not arise from the enriching principles existing in the atmosphere, it is difficult to devise how it could have happened.

Although the hay, grass, straw, &c. were made into better manure than it is probable these substances afforded in their native state, the cattle which were fed on the hay, grass, corn fodder, &c. were bought in lean, and sold out to the butcher fat. They of consequence took away with them more enriching matter than they brought; and all the enriching matter left by them in the dung, was the produce of the food eaten by them. But it should be observed that the fields which were not under cultivation were in grass, and so managed, that they derived every advantage which might be rationally expected from the rich matters floating in the atmosphere. The dung was carefully gathered and ploughed under the soil, previous to any material waste from fermentation. However, the cultivation of the crops was too seldom calculated to save it from useless waste.

I have mentioned before, that as maize is large, the economy of it is more readily observed than that of many other plants, and that it may be clearly seen that this plant gathers much of the nutriment by which its ears are formed and matured from the atmosphere.

The economy of the kidney bean, together with that of all the plants, which penetrate the soil, with the seed from which they vegetate attached to the extremities of their stems or plume, demonstrates, that nature has ordered or contrived plants so, that they have the power to convey the nutritive matter found in contact with their tops, throughout their whole general system, equally as well as that imbibed by their roots. This very interesting part of the economy of nature has also been very ingeniously determined by art, as by planting the tops of some kinds of trees in the ground, and elevating their roots in the air, the buds which usually form leaves become roots; and those which when in the ground, formed roots or radicals, were changed into leaves, flowers, &c.

The kidney bean, when it comes up through the soil, brings the seed with it. The bean, in the process of vegetation, is split lengthwise. The colour of it is but little changed, and but little of the nutritious matter seems to have been exhausted previously to its appearance above the soil. After this, the two sides separate wider apart, and seem to flatten more or less daily, until they are formed into leaves; the colour of them gradually growing greener, in proportion as the nutriment contained in them is exhausted by the infant plant. My examination of the leaves formed by the bean, has unfortunately been carried no further. Therefore I do not

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know that these leaves grow as large, and are as perfectly formed as the other leaves of the plant.

Dr. Darwin says, "The seed lobes of this plant are converted into leaves, and perform the office of lungs." But he is certainly mistaken in saying, "they have given up beneath the soil the nutriment which they previously contained."* This is a very gradual and a highly important process of nature, whether it be performed either above or within the soil. In the case of the kidney bean it is, however, evident that this process is principally performed above ground.

The thinning and suckering of maize, has ever appeared to me to be a very important part of the proper management of that crop. Therefore, I have given much personal attention to both; and have pulled up plants from twelve to fifteen inches high, with a part of the seed still attached to the root: but in common it is decayed before the plants are so large.

However, so far as my observation has extended, it would seem, that the fermentation and decomposition of seed greatly depend on the exciting causes found in contact with it. This appears to be still more probable, as we all may see that seed vegetate very precariously when sown in an old worn out soil: also, that on such soils the seed of those grasses which require much nutriment, remain torpid until the grounds are enriched.

Those circumstances seem to show, how it happens that plants from seeds coated with gypsum, previously to their being sown on a thin soil, are so much more luxuriant than those sown on the same description of soil, without being covered with that substance.

The gypsum hastens the decomposition not only of the richer matters stored up in the seed, but also the outside covering of it which is less nutritive, and of consequence sinks lower into decay. It would appear, however, that neither of these substances is soon enough decomposed by the feeble fermentation which occurs in a thin soil. Therefore the plant growing from seed thickly coated with gypsum, is well supplied with the nutriment which nature has prepared for its support during its infant state. This causes the organization of its system to be much more perfect and robust;† and of consequence much better calculated to perform the functions of life, than a plant which, from a slow and scanty supply of the same kind of nutritious matter, becomes debilitated, and of course much more imperfect in the organization of its system; therefore has not sufficient strength or power to extend its roots deep and wide, in search of the thinly scattered nutriment afforded by a poor soil. As the tops of plants thus circumstanced are equally as much debilitated, and as imperfectly organized, as are their roots, but little nutriment can be gathered from the atmosphere by them.

* See his Phytol. page 23.

† No question but the gypsum with which the seed is coated acts powerfully on the animal and vegetable matters found in contact with it, and that this, like leaven, spreads fermentation.

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Here again we see the close analogy which exists between plants and animals. If a pig or a calf be weaned while it is young, or can obtain but a scanty supply of the nutriment provided for its early support, and the husbandman does not supply this defect by proper nutritious food, we observe that the animal becomes meager, feeble, mangy, pot-gutted, inactive, and its hair is long, dead, and shaggy. In fact the organization of its whole system commonly becomes debilitated and deranged. It also seldom happens that an animal which has been thus neglected and stunted, can ever be so much restored as to attain the same perfection as those that have been well provided for during their infancy.

In the fall of 1814, I turned under a soil thinly set with native grass, principally white clover; but as it has been my lot to follow perpetual ploughers, or rather scratchers of the soil, it was thickly set with brambles and sprouts from the roots of the girdled timber. The soil had been much exhausted : it had been, however, long enough abandoned by the man who had destroyed the timber, and ruined the soil, to be covered by nature with the vegetation above described. Early in the ensuing spring, wheat was sown on the lay. This was covered by the tined harrow, and red clover seed sown on it. The wheat plants generally looked weakly, as soon as they penetrated the soil, and in this state they continued, until the crop was matured. It would appear that the energy of the plants was not sufficient to penetrate the slowly decaying sod formed by an impoverished soil, in time to obtain a tolerable supply of nutriment from it.

The crop was so scanty that it determined me to procure ashes to dress another field of the same description of soil, and exactly in the same condition, which I had resolved to lay down in red clover, by the same mode of management. It, however, so happened that but few ashes could be saved, and these were more or less injured by rain. They were spread over about half the field, but so thinly that little perceptible good was expected from them. This induced me to coat the whole of the seed with as much very finely powdered gypsum as would adhere to it. The plants, on their first appearance, looked healthy and vigorous, as well where the ashes had not, as where they had been spread, and so they continued to do. I am now reaping the field, which, from first to last, has caused much surprise to all my neighbours, who knew the grounds, and how much they had been exhausted; especially those who had examined the product of the first mentioned field. I believe the produce of the present field cannot be estimated per acre, at less than double that of the former one; although the soil, cultivation, and condition of both were exactly the same; except that no gypsum was employed in the former instance. The crops of spring wheat were generally quite as good, if not better, last year, than they now are. I will conclude my book on vegetation and manures by observing, that the manures arising from the tops and roots of the grasses ploughed under the soil, are so closely connected with cultivation, that the

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best modes of obtaining them, will naturally occur in a description of that cultivation best calculated to gather, apply, and preserve them from waste.

In this description, which will appear in my next book, it will, I trust, be clearly seen, that incalculable advantages may be obtained, from the proper application of the roots and tops of the grasses for manure; that they may be so applied and managed as to produce at least double the advantage, both to the crops and the soil, that has been obtained from them by the too general mode of management. Also that the grasses in the hands of a judicious cultivator are nature's certain restorative; the only rational means by which the farmer will be enabled to restore exhausted soils, and keep them with that part of their own produce *alone*, which he may readily spare, constantly as well stored with decaying animal and vegetable matter, as they were when subjected to the simple but wise economy of nature alone. Likewise that an immense loss in the tops and roots of the grasses, and also in farm yard manure, as well as in the fertilizing principles floating in the atmosphere, naturally arises from the present too general mode of management, both in the application, and cultivation after they have been applied. And that, by a proper system of husbandry, these losses may be readily avoided, and the value of the crops greatly increased; the soil enriched, in place of being exhausted, and far better prepared for succeeding crops, with much less labour and expense than generally occur in the usual way.

After this has been done, if the reader will sum up the various losses in manure, that naturally arise from the present too general mode of gathering and managing of it, and also from an injudicious and irrational cultivation, he will certainly find them excessively great.

When calculations are made on principles that cannot be certainly established, they will not be correct. Still, it seems probable, from what has been generally advanced, and also, from what happened on the farm mentioned above, that if the immense sums of money or labour expended in the useless and destructive attempts to make animal and vegetable matter a better food for plants, also in a laborious and injurious cultivation, were spent in procuring the litter, and saving the dung, which is now too generally wasted, that the produce of the United States would be at least doubled in the course of five years; without estimating the aid which may be derived, during that time, from the increased agricultural capital, and population, that is to be expected from the great influx of foreigners, or in fact any other aid, than that of proper management.

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BOOK II.

ON CULTIVATION.

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CHAPTER X.

Remarks on putting in small grain on stubble grounds. A degree of merit is justly due to a naked fallow executed in the usual way. The disadvantages arising from that practice considered. The usual mode of cultivating fallow crops contrasted with the practice recommended by the author. Observations on the value of grass lays, and the proper cultivation of them. The red clover plant is destroyed by frequent mowing and close pasturing. Fermentation, properly directed, is the main spring of vegetation.

THE worst system of cultivation in common practice seems to be stubbling in; or annually putting in crops of small grain on stubble grounds. This is too generally practised every where, but especially in the back-woods, until weeds and poverty of soil united, reduce the product so much that the crops fall far short of remunerating the cultivator for the labour bestowed on them. When this happens, he generally resorts to a naked fallow. This is too often badly executed. Still, many of the weeds that would have choked and robbed the plants of much nutriment, are destroyed: consequently, the product is increased in proportion to the food remaining in the soil, and the cultivation bestowed on it.

A naked fallow is certainly a very laborious and injurious practice. It is also equally certain that any soil may be much better prepared for a succeeding crop of wheat, or any other small grain, by a fallow crop properly ordered. Still, a naked fallow should be allowed all the merit justly due to it; especially by those who mean to controvert that practice.

When it is well executed, the soil is finely divided. The animal and vegetable matter, which was before locked up in the hard clods of earth, impervious to the roots of the plants, is brought into more immediate use. The enriching and fertilizing matter floating in the atmosphere is more freely absorbed, and better secured, by an open, free soil, than when it rests on one of a contrary description. The roots of the plants are also enabled to dip deeper and spread wider through the soil, in search of the nutriment provided for them. It is true, if the ground be very sandy, a naked fallow, by opening the texture, makes it less fit for the roots of plants, and causes much injurious evaporation from it; likewise, when an adhesive clay has been finely pulverised, heavy rains, succeeded by a hot sun, or drying winds, cause it to bake, and become impervious to the roots of plants: but, except the advantage derived from the shade of the fallow plants, the same happens both in clay and sand, when the soil is prepared for small grain by a fallow crop cultivated in the usual way.

Jethro Tull, the ingenious inventor of the drill husbandry, grew

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exhausting crops annually on the same ground, without the aid of manure, although his soil seems to have been thin.

Sir H. Davy says, "Jethro Tull, in 1733, advanced the opinion, that minute earthy particles supplied the whole nourishment of the whole vegetable world; that air and water were chiefly useful in producing these particles from the land."* If Sir H. had quoted the words of this truly great, but very mistaken agriculturist, the question would have been determined. Some years have elapsed since I read Mr. Tull's book on agriculture. If my memory be correct, he attaches more consequence to the depositions from the atmosphere than Sir H. seems to imagine; and appeared to believe they were conveyed to the soil by the dews. However, Mr. Tull's practice alone is sufficient to determine, that vegetation is greatly promoted by finely dividing the soil; particularly when the cultivation is extended to the growing crops. The practice of ages clearly shows, that much more is to be expected from a naked fallow than too many advocates for fallow crops seem to believe. Still, if Mr. Tull had lived until he had divided the soil sufficiently often to have extracted the animal and vegetable matter that the undivided clods contained; also, to have decomposed the hard vegetable substances which are always more or less seen, in greater or smaller quantities, in all soils; his opinion respecting enriching manures would have been greatly altered; as was that of Mr. Duhamel, a distinguished agriculturist of the same school, but who lived long enough to see the fallacy of this inconsiderate theory, and also to abandon it.

Having candidly stated every advantage that seems to be derived from a naked fallow, I will enumerate the very serious disadvantages and injurious consequences arising therefrom.

It is an expensive practice. First, the loss of one full year's rent of the soil. Secondly, it must be frequently ploughed, harrowed, and rolled. After this, it often happens that much manual labour is necessary to break the clods, especially when they are firmly bound together with the roots of the grasses and weeds. These are pushed about by the plough, dragged by the harrow, and sunk into the soil by the roller, but not sufficiently separated by any of them. The remains of them, together with the more finely divided grasses and weeds, are dragged up into heaps by the harrow throughout the whole field. These are raked up into larger heaps and burned, by some cultivators. Others suffer them to remain, and when the seed is sown, the harrow, by dragging the heaps, drags up much of the seed with them; and vegetation is destroyed wherever they may happen to lie. In either case, a great waste of vegetable matter takes place; for when it is not burned, its best properties are exhaled by the sun, or scattered in the air. Numbers of men, women, and children are sometimes seen in England breaking the hard matted clods into pieces, raking them up into heaps,

* See his Lec. on Agr. Chem. page 14.

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and burning this very valuable vegetation, which, without any of this enormous waste of labour, might have been very profitably applied to the growth of the crops, and improvement of the soil. After the utmost care has been taken to prepare a naked fallow in the usual way, a multitude of the roots and tops of the grasses and weeds remain so intimately mixed within the soil, that they will grow in sufficient numbers to do great injury to the crop: especially if the weather happen to be dripping during the process of cultivation. In that case, the moisture preserves the vegetative powers of the grasses and weeds, and the crop is sure to be much injured by them.

The seeds of the weeds are as often turned under as uppermost by the usual mode of cultivation: consequently, many of them do not vegetate during the process; and those that are not buried beyond the power of germination, when the small grain is sown, will grow and injure the crop. If dung is applied for the small grain, it is generally spread previously to seeding, and turned under by a shallow furrow; of consequence, it produces a plentiful crop of weeds, for although the cookers of dung say that the fermentation of it destroys the vegetative property of seed, practice and observation determine the contrary.

In fact, if nature had not calculated seeds in general to withstand much more than the heat of a fermenting dunghill, the earth would long since have been stripped of vegetation; particularly where ploughers and croppers reside. Like the locust in Egypt, they would soon destroy every green thing, if nature had not reserved seeds for ages unhurt, with which she carefully counteracts so much of the injury done by this class of farmers, as to prevent actual sterility from taking place in the grounds cultivated by them.

Although it is granted, that a naked fallow prepares much food for plants, by finely dividing the soil, frequent ploughing and harrowing are calculated to scatter much animal and vegetable matter in the air; especially while the soil is continually exposed to the injurious effects of the sun and air; and unless the bad effects produced by this process be counteracted by excellent management in other respects, it will eventually ruin the soil. If this practice be pursued, under the best mode of management, that superior talents can devise, the improvement in the soil will be slow indeed, when compared with that which may be readily effected, by the practice of fallow crops properly ordered. It is also evident, that in the latter case the grounds are profitably employed, while in the former they yield nothing: although the farmer is spending much money in the very laborious cultivation of them.

No improvement made in agriculture has promoted the interest of it so extensively as the introduction of fallow crops. Yet it seems evident, that the various different modes which have been generally pursued in the cultivation of these crops, as well as in that of the cultivated crops following them, are by no means calculated to promote the product of either, or to enrich the soil, to

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any thing like that extent, which might be readily effected with much less labour and expense, if a proper system of cultivation were pursued. If, however, distinct parts of the very numerous and discordant systems of cultivation be selected from the different practices that are commonly pursued by different cultivators, it appears that nothing is offered by me, which has not been more or less sanctioned by the actual practice of others. Therefore, the merit of my system of husbandry does not consist in overturning what the practice and observation of ages have introduced: but in uniting into one system such practices as are consistent with nature, reason, and common sense, rejecting those only that seem to be inconsistent with either. The undertaking is arduous, especially when ventured upon by a plain practical farmer, who depends not on science, but on nature, reason, practice, and observation. In a work of this sort, errors are to be expected; still, as these errors cannot be capital, but little injury is to be expected from them, before they may be corrected by others who are better informed.

Agriculture will never reach its zenith, until the value of grass lays is sufficiently appreciated, and the cultivation of them much better understood. The value of a clover lay, when applied for wheat, is well known. Still, most farmers continue frequent mowing, or close pasturing, until the clover is nearly run out. This greatly impoverishes the lay, and unless the soil be rich, the wheat crop is light. The clover plant cannot withstand frequent cutting, even during the first season it is mown. This causes the lateral roots of the plants to become weak, and incapable of holding the tap-roots in the ground; and they are thrown out by the frosts of the ensuing winter and spring. The same happens if red clover be pastured, unless a well grown covering of the tops of the grass be preserved; especially to defend the roots and crown of the plant, from the frosts of the ensuing winter and spring. If this plant be thus defended, it will far better withstand, not only the frosts in the winter and spring, but also the injurious heat of the sun.

Both red clover and speargrass lays are very justly esteemed, by many farmers, as the best preparation for a fallow crop of maize. Some, either to save labour, or from a just conviction that the value of the crop is also greatly increased, do not turn up the sod in the cultivation of the fallow plants. Too many of them, however, as well as other cultivators, believe the health and vigour of the plants are greatly promoted by harrowing over them while they are young. Some, also, use harrows with sharp cutting tines, for the purpose of cutting through the sod deeply, and as near to the stems of the plants as may be conveniently done, without cutting or tearing up. These practices are certainly opposed to the economy of nature, and the enlightened reason of man. None of these gentlemen would wound, bruise, or mangle a young animal, to increase the health and vigour of it; neither would they rend

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and tear the choice trees in their nurseries to make them grow better; although less evil would arise from mangling them, as trees are calculated much better to withstand and outgrow this very manifest injury. The practice of mutilating the tops, and separating the roots of plants from their stems, for the express purpose of causing them to grow much more luxuriantly, is not confined to maize; potatoes, and other hardy plants, that are capable of withstanding this truly barbarian practice, are too often subjected to it.

Although some farmers do not turn up the sod in the cultivation of maize, all of them, so far as my observation extends, plough it up previously to seeding the small grain that follows this plant. This exposes the rich matter arising from the fermentation of the roots and tops of the grasses, and the dung also, if that has been applied, to a serious waste. It is exhaled by the sun, scattered in the winds, and washed away by the rains and melting snows. Fermentation, which is the main spring of vegetation, is checked. None of these evils happens when the small grain is put in by a superficial cultivation; as the rich fertilizing matter remains securely buried within the soil. This, nature applies, with the least possible loss, to the use of the cultivated crops, and the grasses following, and with the overplus she enriches the soil. The fermentation and decay of this enriching matter, more effectually expands, and minutely divides, the soil, than can be done with the plough. The plough, harrow, and roller, with, too often, the addition of very expensive manual labour, are capable of pulverising the soil to any desirable extent. After this has been done, it settles, and too often becomes impervious to the roots of the plants, unless the ground be so rich, that it is not materially affected by the loss of the animal and vegetable matter which always takes place, when the soil is cultivated in the usual way.

It should, also, be recollected, that every crop which is sown broad cast, principally depends on the expanding force of fermentation, to keep the soil open and mellow, for the ready admission of the roots of the plants; likewise that when the grain is filling, the plants require the most nutriment; and that previously to this the soil is considerably consolidated by time, unless it has been kept open and mellow by the fermentation of the animal and vegetable matter contained in it, or consists principally of sand. In the latter case, the lack of animal and vegetable matters causes much injurious evaporation of moisture, This, if the season does not happen to be dripping, greatly reduces the product of the grounds.

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CHAPTER XI.

Fall ploughing for a crop of maize considered. The injurious effects of turning up the sod and manure in the cultivation of a fallow crop explained. Also by turning it up for the small grain following that crop. Plants are greatly injured by cutting their roots in the usual mode of cultivation. The advantages derived from a superficial cultivation of a fallow crop considered. The nutriment arising from weeds should be as carefully applied and preserved as that from our favourite plants. Maize is the best fallow crop if the cultivator has the destruction of weeds especially in view. Potatoes may be justly ranked among the worst of crops to effect this purpose.

If some extra labour done through the fall and winter, (of but little consequence either pro or con) be excepted, Judge Peters' practice in the cultivation of fallow crops of maize grown on grass lays, is very similar to that of many other farmers, who cultivate this plant on a sod with the plough; I therefore believe it will be very useful to make some remarks on his different modes of management, especially as he had the destruction of garlic and other hardy weeds particularly in view. It would also seem that a reference to a recorded practice is likely to be more impressive, than if I were to refer to the same practice as it is generally pursued.

I will commence with the crop of maize grown by this gentleman in 1809. His management of it so far as it was proper, clearly confirms the practice recommended by me. Also as clearly determines the injurious consequences arising from turning up the sod, in the cultivation of the plants.

He says, "In the autumn of 1808 I ploughed my field from five to seven inches deep. The sod was tough, and the surface bound. I treated it as I have been accustomed to deal with similar soddy lays. I harrowed it frequently in the fall, and, in open weather, in the winter, to expose the garlic, and fill all the openings, admitting too great an influx of air. To close them and consolidate the mass, I rolled it well."

Those who do not follow my practice in old lays newly broken up, object to fall ploughing; because in the spring, after fall ploughing, they cross plough, and turn up the sod with all its *pests* and *adhesion*. ***This I never do***, but harrow it well and often. I marked out the field in squares for Indian corn, and planted it at the usual time, not disturbing the sod, except in a small part of the field, hereafter noticed; the corn thus treated does not, at first, grow so vigorously as in the common way, but as soon as the roots have penetrated the rotting sod, and mixed with the putrefying vegetable substances, the plant is wonderfully rapid in its increase, and im-

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provement in colour and vigour. When the corn requires ploughing, the sod is completely decayed, and becomes a manure. "I have a confirmation of the usefulness of my practice of rotting the sod. In the spot so often ploughed, the old vegetation dried, and perished uselessly, and the Indian corn was strikingly inferior to that on the rest of the field."*

When farm yard or other enriching manure is not applied for a crop of maize, fall ploughing, rolling, and harrowing, is an excellent practice. The tops of the grasses are not scorched and dried by the frosts through the winter. The rolling previously to harrowing, settles those parts of the furrow slices, which by lying hollow are raised above the rest. The harrowing closes the seams between the furrow slices; especially as succeeding rains, wash the loose soil into them; this greatly retards, and also partially prevents the growth of the grasses from the sides of the openings between the furrows; also, by excluding much air, predisposes the sod to an earlier fermentation in the spring. Harrowing after this is injurious; it opens the soil; and this not only procrastinates fermentation, but also encourages the growth of the grasses from every part of the sod. But as Judge Peters rolled after harrowing, it is probable that the extra rolling and harrowing did neither good nor harm; unless the cost of this useless labour be estimated.

However this gentleman's practice furnishes valuable information. It shews that "as soon as the roots of the corn plant" have penetrated the rotting sod, and mixed with the putrefying vegetable substances, it is wonderfully rapid in its improvement in colour and vigour; it is especially worthy of remark that, "in the spot so often ploughed, the vegetation dried and perished uselessly, and the Indian corn was strikingly inferior to that on the rest of the field."†

The extra ploughing of this small spot, by turning up the sod, checked fermentation: also exposed the roots, and the tops of the grasses and weeds to the useless waste described by Mr. Peters; consequently a lack of nutriment caused the corn growing on it, to be "strikingly inferior to that on the rest of the field." Whereas the fermentation and partial decay of the tops and roots of the grasses and weeds, which took place in the larger part of the field, previously to ploughing up the sod in the first cultivation, predisposed it to ferment more freely after it had been turned up, than could have happened in the small spot, where the sod had been frequently disturbed by being so often ploughed. But notwithstanding these marked advantages, the crop on the larger part of the field sustained great loss, in consequence of turning up the sod. Fermentation was greatly checked; also the nutriment arising from that part of the grasses and weeds, which had been decomposed, was exposed to the very injurious influence of the rain, sun, and air; and a considerable proportion of the vegetation which was not

* See Mem. Phil. Agr. Soc. vol. ii. pages 178, 179, and 181. † Ibid, 181.

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decomposed perished uselessly, as did that on the smaller spot which had been so often ploughed.

The President says, when the corn requires ploughing, the sod is completely decayed, and becomes a manure: this should be better understood. Although the roots of the grasses have been reversed, many of them grow freely, and are often found very difficult to be subdued, even when the first cultivation takes place before the plants are in general four inches high.

When the first ploughing is done much later than this, the sod, in place of being decomposed, is commonly turned up in chunks, on which the tined harrow makes so little impression, that a multitude of them, or the remains of them, may be seen on the surface of the soil when the corn is gathered. I have seen when the soil was not hard bound, and the corn not ploughed until the plants were twelve inches high, the roots of the grasses dragged up by the tined harrow (which followed the plough,) in large heaps on the surface of the soil; where this valuable vegetation generally perished, with but little benefit even to succeeding crops, or the land.

Many cultivators to avoid this obvious evil turn up the grass lay tolerably deep, and with great dexterity turn a very shallow furrow when the corn is first cultivated, and the soil is but little disturbed. Strange however to tell, after this very prudent precaution, all of them (so far as my observation extends) plough deep the second time, for the express purpose of turning up the sod, and mixing the vegetable matter with the soil. They however might have seen that this checks fermentation, and exposes the animal and vegetable matter to great waste. Also that the roots of the plants at this time fill the soil in every direction, and the greater part of them are cut off and destroyed. Thus nature is compelled by this very inconsiderate practice to employ her efforts in restoring the roots of the plants, in place of applying them to the growth and maturity of the crop. However, when the corn plant is established in a tolerably good soil, and is kept free from weeds, it is strong and hardy, and notwithstanding this truly savage treatment, it will grow and produce valuable crops.

Certainly this mode of management, (though much better than that which is generally pursued,) is far from harmonizing nature and reason in the practice of husbandry. For when the corn plant begins to shoot its prop roots, tassels, and ears, it requires every assistance that nature and art can afford, until the grain be filled. Of consequence cutting its roots, checking fermentation, and exposing the animal and vegetable matter to useless waste, are opposed to the economy of nature and the unprejudiced reason of man.

I have often seen whole fields of corn that looked green and luxuriant, before the prop roots, tassels, and ear shoots appeared, that immediately after this very trying crisis turned sallow, and became unproductive, merely because a sufficiency of nutriment had not been provided to perfect the number of plants which had been arranged on the soil; or the nutriment had been uselessly

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wasted, and also rendered inactive, by an improper cultivation, which likewise inflicted the additional evil of mutilating the roots of the plants.

The President says, when "the sod is completely decayed," it "becomes a manure." It should never be forgotten, that it "becomes a manure," so soon as fermentation and decomposition commence. This is clearly seen by the corn plant growing slowly, until these very interesting operations of nature, begin to convert the roots and the tops of the grasses and weeds into food for them; also, by observing that after this, "the plant is wonderfully rapid in its increase, and improvement in colour and vigour." It should likewise be well remembered, that, after "the sod is completely decayed," much of the nutriment which was contained in it, has been applied to the use of the crops grown on it; and that the remaining part of this nutriment ought to be kept secure from useless waste, that it, also, may be expended in the same beneficial way. The proper use of animal and vegetable matter, and the useless inconsiderate waste of these substances, are vastly more important to the interests of agriculture, than the writers on this subject seem to imagine. It is therefore considered useful to show that Mr. Peters destroyed much of this nutritious matter, in his procrastinated and very laborious destruction of the star of Bethlehem. This it appears had overrun the ground now under consideration: he says, "I was mortified by the discovery in this field of a new *enemy* which defies all my efforts to subdue it. Mixed with some compost, made in part, of the cleanings of my garden, which had been spread several years, were a *few bulbs* of that *destructive pest* the star hyacinth, from which the increase has become ruinously great." "Flowers, innocent and grateful in the parterre, are often *pests* in the field." "But the one now mentioned does not always thus originate." "Thousands of acres, through the country, are rendered worthless by this agriculturally *vile* plant," it *exhausts far beyond garlic;* "meadows and fields once fertile and productive, are rendered by it *barren* and *worthless.*" "I earnestly wish that farmers would take the *alarm*," all I can do, until I pursue farther means, is to give "*solemn warning.*"

"In the spring of 1809,* I took the resolution, to hand weed an acre of the worst part of my field. I turned in the plough, and had a man to lead boys, in hand weeding after the plough and harrow, but could not get through above half an acre; from this I collected, in repeated ploughings and harrowings, at least one hundred and fifty bushels of bulbs; but the boys grew tired and I abandoned the task." "My field remained remarkably clean and free from weeds; an advantage attending this mode of treating soddy grass grounds." "The field is now winter fallowed and limed, in preparation for field peas, *potatoes* and other *ameliorating* crops to precede wheat. It is in fine tilth, and the former covering

* The dates seem to clash.

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of grasses, and other common vegetation (with the exception before stated,) entirely rotted, and mixed through the ground mellowed by culture." "The garlic I do not fear, but too many of the other bulbs remain to annoy me; an early spring ploughing will, under its present fitness for it, be highly serviceable, and complete its tilth; this will do as much good as one immediately after the first fall ploughing would have done mischief."

It is difficult to conceive how it has happened that the President in this communication, says potatoes are ameliorating, and employs them as a proper preparative crop for wheat. In the third volume of the Memoirs, when speaking of this plant, he says, "that it is an *exhauster* we have *long* known;" also, that, "it should be cultivated as a crop *by itself*, and not in *connection* with a grain course."*

Of the star hyacinth, or star of Bethlehem, we hear no more until the third volume of the Memoirs is published; in that this gentleman tells us, that, "By potatoes and frequent ploughing in autumn and early spring, I have conquered the pest I mentioned in the second volume, p. 178, the star of Bethlehem: his had alarmed me more than any other weed." "The bulbs where brought into my field among unrotted litter from my garden.†" In the second volume he says, "mixed with some compost made *in part* of the cleanings of my graden were a *few bulbs* of that *destructive pest* the star hyacinth, from which the increase has been ruinously great." Compost does not seem to be unrotted litter brought into a field from a garden.

However, as the President tells us the star hyacinth "does not always thus originate," it seems to be but of little consequence how this plant got into his field: especially as it seems to have been the native companion of poverty and bad cultivation in the "thousands of acres," "meadows and fields," which, he says, "were once fertile and productive," but had been "rendered barren and *worthless*" by "this agriculturally *vile* plant," "which exhausts far beyond garlic."

It has never been proved that garlic exhausts the soil. On the contrary, it requires so little nutriment that it will thrive and abound on soils which have been so much exhausted by bad husbandry that none of the cultivated grasses can prosper on them.

It may be laid down as a maxim in farming, that any vegetation which can be ploughed under the soil is far better than none. Also, that the profit arising from the proper use of garlic, or any other weed, is increased in proportion to the increased quantity that may happen to be growing on the soil. Neither the tops nor the bulbs of garlic appear to be deficient in nutriment. The latter especially seem to be well calculated to return enriching matter to the land. But as nature has constructed bulbous rooted plants, so that cultivation makes but little impression on them, while their vegetative

* See Appendix of vol. iii. page 54.
† See Mem. Phil. Agr. Soc. vol. iii. page 235.

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properties remain dormant, and but too few farmers have given sufficient attention to this circumstance, it has been found difficult to subdue them. However, neither they, nor any other plant, can withstand repeated mutilation, while their vegetative powers are in action; especially if the cultivation be so ordered, that none of the plants which vegetate so as to approach near the surface of the soil, can escape being cut off a little within it every time the growing crop is cultivated. By this means the part remaining within the soil is severely wounded, and being also closely covered by the earth above it, a powerful fermentation is promoted; consequently, the ultimate destruction of the plant, (be it what it may,) is more certainly effected than by any other method which has yet been proposed. The common plough does not sufficiently mangle the roots of any kind of grasses or weeds, and but very few bulbous roots can be cut or mangled by it. Whereas none of the stalks or stems of any weed or grass, that approach nearly up to the surface of the soil, can escape the operation of the hoe harrow, when properly used in the superficial cultivation of a fallow crop; except those standing between or very near to the growing plants, and there the hand hoe is equally effectual. The same also happens when the soil is prepared by the hoe harrow, for the small grain that follows the fallow crop; especially as the tined harrow, (which should always immediately follow the hoe harrow,) overturns and severely mangles the vegetation which had been cut off by the latter a little within the surface of the soil. To illustrate this: nature having intended the grasses for the food of many animals, has so constructed them, that they are not eradicated by being very frequently, and also closely, cropped or cut off. Still, it will be found that no method in common practice, except deep trench ploughing, or rooting them out, will so soon and as effectually destroy the hardiest grasses as frequently cutting them off a little within the surface of the soil, and keeping the roots below this point closely covered by the loosened earth above them.

This is clearly seen when a scuffle (or D hoe, as it is called by some,) is used to destroy the grass in garden paths, which had been covered by nature or art with a sod. The cause is evident, for a powerful fermentation is promoted in the wounded grasses by the covering above them. A very similar effect is also produced, if a small bunch of hay, or a board, or even a piece of a close wove mat, happen to fall or to be laid on a sod. If the covering be removed after the grass roots under it have been decomposed, it will be found that the powerfully expanding force of the fermentation excited by this trivial cause, has made the soil more open and mellow, and also divided its parts more minutely than could be accomplished by the usual mode of cultivation, provided the soil be well stored with the roots of the grasses; for the fermentation will be in proportion to the animal and vegetable matter found in it.

The result of Judge Peters's practice in the destruction of the star hyacinth "pest," seems to determine that nature had filled up the

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vacancies in his grass grounds with a plant that was more difficult to be subdued than many others which might have been vastly more useful to him: also, that of this he had no right to complain; for the evil could have been readily avoided by proper management. The plant, far from being a desirable one, was by no means very difficult to be subdued; for no part of his management, except that before the first cultivation of the corn crop, was well calculated to effect this end. If the vegetation introduced by the star hyacinth had been properly used during the cultivation of the field, he would have found that nature had been kind in introducing even this hardy plant, where better vegetation had been excluded. It was the farmers who occupied those "thousands of acres," "meadows and fields," who were in their practice and management "*agriculturally vile*," and not the plant which has been so severely and unjustly abused by the Judge. He, however, says, "I find it to be a favourite with our highly intelligent member, Professor Barton, who looks only on its good qualities."

I know nothing of the particular good qualities of this plant. I do, however, know that it and every other plant which can be readily ploughed under the soil, may be converted into very valuable manure; also, that every plant found in our fields should be as carefully applied in this way, as any of those which are justly more highly esteemed by us: likewise, that if the farmers who occupied those "thousands of acres," "meadows and fields," had kept their grounds well cultivated, even in the *usual way*, they would not have been overrun with the star of Bethlehem, or any other plant that did not suit their purpose. This clearly appears in the President's practice; especially as it ceased to be proper so soon as he turned up the sod. For he says "my field remained remarkably clean and free from weeds; an advantage attending soddy grass grounds." "The garlic I do not fear; but too many of the other bulbs remain to annoy me."

Thus we find that the cultivation of a crop of maize, very imperfectly ordered, reduced the numbers of this (supposed) "*destructive pest*," which was believed to be "*ruinously great*," so much that the cultivator is merely annoyed by it. Also, that "by potatoes and frequent ploughing in autumn and early spring, the *pest* was conquered." The potato is one of the worst plants that can be cultivated with a view to the destruction of weeds. First, because it is planted late. Secondly, it is generally ridged up; therefore, the cultivation of it must be of short duration, or the fruit roots are cut off, and the crop greatly injured.* Thirdly, the bulbous "pests," or the seeds from them or other weeds, are buried underneath the ridges beyond the power of vegetation. Fourthly, when the crop is gathered, these seeds and bulbous "pests" are spread abroad, as if sown to produce another crop of the same description. Therefore, the imperfect cultivation of the President's crop of corn, to-

* That is, when this plant is cultivated in the usual way.

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gether with the cultivation of the potato crop which followed it, were not, (when united,) capable of subduing the bulbous "pest," as effectually as a single crop of maize properly ordered. Neither would this "pest" have been subdued, if the extra ploughings and harrowings done in the fall and early in spring had been omitted.

Maize is one of the best fallow plants that can be cultivated with a view to the destruction of weeds. It ought to be planted as early as frost will admit. It continues long on the ground, and not only admits but likewise requires a very perfect cultivation. No plant seems to suffer more from the injurious influence of weeds; consequently, the superficial cultivation of a crop of corn, together with the cultivation of the soil with the hoe and tined harrows, for the small grain following it, would far better subdue this bulbous "pest," or any other weed, than the practice pursued by Mr. Peters. This mode of management would also save the animal and vegetable matter, which was uselessly destroyed by him; all the beneficial effects produced by a well directed fermentation are by this means brought into active use.

Now as the star hyacinth might have been subdued by two, in the place of three crops; and without the frequent extra ploughings and harrowings done by this gentleman; not only in "autumn and early in spring," but throughout the whole of his very laborious and inconsiderate practice, the difference in labour would have been very great. One ploughing, with the very expeditious cultivation done by the hoe and tined harrows, would have been sufficient for both these crops. Why then did the President "*earnestly alarm*," or "give farmers" a "*solemn* warning," of the imaginary "*destructive*" and "*ruinous*" properties of a plant that might have been very profitably used by him?

If the boys had not "grown tired and abandoned" the tedious "task," and the pest had been subdued by them, is it not probable that, Mr. Peters's very mistaken apprehension of the "*ruinous, destructive ravages*," and "*unconquerable*" properties of this agriculturally "*vile* plant," would have led him to publish that it could not be subdued except by hand weeding, or, by "paring and burning?" The latter he says he should have done, "but his public engagements obstructed him from such employment."

Hand weeding, together with the necessary ploughing and harrowing, would have cost a great deal of money. After it had been done, (unless the soil had been run through a sieve calculated for the purpose,) many of the bulbs would have escaped, especially those that were young and small. These, together with the seed that had been scattered on the soil previously to turning up the sod, would have produced a new and plentiful growth of the "pest." For as both corn and potatoes are commonly ridged up, the bulbs, as well as seeds scattered by the plants, are buried underneath the ridges beyond the power of vegetation, and spread abroad when the grounds are cultivated for the small grain, as if to produce another growth of "pests." The hand weeding would also have greatly injured the

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crop and the soil, by the removal of this very valuable vegetation, which may be seen by the one hundred and fifty bushels of bulbs removed by the President from "not more than half an acre" of ground. This is three hundred bushels to the acre. Equal in measure to an average crop of turnips in this country, where that plant is too seldom hoed or cultivated in any other way. Whether there be more or less nutriment for plants in a bushel of the bulbs of the star hyacinth, than there is in the same measurement of turnips, is unknown to me. It is, however, well known, that some plants which are not relished either by man or domesticated animals, are rich and valuable manure. The turnip has been cultivated for the express purpose of manuring the grounds on which it was grown. When injured by frost, it is applied to that use by attentive cultivators, and found very valuable. Why then should a crop of the star hyacinth, or any other weed which nature has kindly introduced, where the cultivator, either by neglect or mismanagement, has prevented the growth of such plants as would have far better suited his purpose, be uselessly destroyed by great labour and expense, when, for aught we know to the contrary, they may be more valuable for manure than some of the plants which are justly very highly esteemed by us? especially as no plant can withstand the destructive effects produced by a well directed fermentation; and it is certain that there can be but few weeds, which will not yield, in proportion to their number and size, as much nutriment for plants, when they are ploughed green under the soil, as either buckwheat or sea-weed. Both these plants have been found very valuable manure when used in that way. Although, when either of them is decomposed previously to application, the evaporation from them is so great, that the remains are but of little comparative value.

As the destruction occasioned by paring the soil, and burning the vegetation contained in and upon it, has been explained; any comment on what would have happened, by the introduction of this savage practice, to subdue the star hyacinth, would be useless.

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CHAPTER XII.

A proper and an improper cultivation contrasted. The speargrasses let in weeds. Red clover smothers them. Small grain, sown in the spring, favours the destruction of weeds, more than grain sown in the fall. Observations on the lenient properties of plants. The grasses are far cheaper and more enriching than the cultivated crops generally grown and turned under for manure. The application of fresh dung advocated. It does not, as we have been told, "burst the vessels of most valuable plants." Neither does it "produce in grain crops, smut, blight, and mildew;" nor do "myriads of mice and moles infest potato crops," in consequence of the application of "strawy muck" as manure for this plant.

JUDGE PETERS's practice, in his fallow crops of maize, grown in 1808, and the cultivation of the crops following it, seem to afford subjects for interesting remarks: particularly as the management of the corn crop, (except some extra labour done with a view to destroy garlic,) is the same as that pursued by many farmers who turn up a grass lay in the fall, and plough it again in the spring previously to planting, which, as this gentleman very justly remarks, when describing the management of his corn crop grown in the following year, "turns up the sod with all its pests and adhesions."

Of the crops now to be considered he says, "I have now a fine field of wheat. Two years ago it was so infested with garlic, that the *hay*, in winter, was unfit for my cows; as it gave the milk a most disgusting taste. In 1807, I gave it a fall ploughing; and in the spring of 1808 I ploughed it again, as early as the frost permitted. At the usual time I planted Indian corn." "I cut off the cornstalks, fall ploughed, and limed lightly. Wishing to cover my fallow in the spring, I procured Albany peas. I was obliged to send to New York for my peas, which occasioned delay; and, although I ploughed early, I sowed a month too late." "They came up evenly, and looked remarkably well, till the pods appeared, when heavy rains laid them, and I lost my crop of peas; but did not lose the benefit of their cover. Two acres of the same field were highly dunged, and planted with potatoes; I sowed wheat in the potato ground, ten days before my pea fallow was ready. A remarkable dry season prevented my sowing in the time I wished. During the drought, I gave an extraordinary ploughing, to cover and protect a moderate dressing of well rotted dung, on the pea fallow.* About the middle of October, I harrowed in my wheat, sowed on it timothy seed, and rolled it in."

* This should not be called an extra ploughing, as the dung could not have been covered without it.

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" The garlic is apparently destroyed in the whole field. I could, in the winter, have collected many bushels of dead bulbs of garlic; which had been exposed by the harrow after the fall ploughing. In this way I have cleared many a field of garlic; but in three years (often in two) the seed, which had been lying torpid, vegetated, and produced a new crop of *pests*. I have a field adjoining, preparing for a similar course."*

The President's remarks on the small spot so often ploughed in his corn field of 1809, together with my observations thereon, are sufficient to explain the very bad consequences arising from " turning up the sod" in the spring, " with all its pests and adhesions." It, however, seems strange, that in 1808, this gentleman should do this, although he tells us, in 1809, " this I *never* do." He likewise enumerates the advantages derived from letting the sod remain undisturbed until the corn be ploughed.

The field now under consideration was ploughed five times, and very frequently harrowed before the peas were sown. It is not said how often it was rolled, or how often it was ploughed, in the cultivation of the fallow crops. Enough, however, is said, to determine that the amount of useless and very injurious labour was very great; whereas one ploughing, with the remainder done by the hoe and tined harrow, would have executed the whole much better, and with very little comparative expense, if the grounds had been properly ordered.

The liming provided food for the pea crop; but this was done at the expense of the animal and vegetable matter found in the soil. The well rotted dung afforded nutriment for the wheat, but half the original quantity would have done this, if it had been applied previously to fermentation. However, as dung, (whether it be or be not decomposed,) introduces weeds when applied for small grain, the original quantity ought to have been applied for the corn crop, previously to its being uselessly wasted by fermentation: especially as this arrangement would have more than doubled the quantity of corn, and also furnished sufficient nutriment for the wheat crop. If the garlic and other " pests," together with the roots and tops of the grasses, be kept under, and properly used within the soil, in place of being uselessly destroyed on the surface of it, the ground would have been enriched for the growth of the grasses following the cultivated crops; also improved for the growth of a succeeding round of crops; and the cost of the lime, as well as the extra labour, might have been saved, with one year's rent of the land.

If the pea crop had not failed, the increased product of the corn would have been more valuable than it. As from seventy-five to eighty bushels of shelled corn per acre, is but a moderate crop of that grain, when as much fresh unfermented dung is applied to the acre, as will, after it has been rotted, be sufficient to manure an

* See Mem. Philad. Agr. Soc. vol. ii. pages 126, 127, 128.

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acre for wheat. Now we know, that the "general rate of crops" of maize grown without dung, (as was the President's, and as is the too general practice,) does not under the favourable circumstances of a grass lay, average more than thirty bushels of shelled corn to the acre. That this gentleman has not been accustomed to get much, if any more, than this, when the crop has derived no advantage from dung, may be clearly seen in a note made by him in the second volume of the Memoirs, page 203.

Wheat sown in the fall continues too long on the ground to favour the destruction of garlic, or other hardy weeds. Therefore spring wheat, barley, or oats, should in this case be sown.

The superficial cultivation for the spring crop, will have a powerfully destructive effect on such weeds as may happen to vegetate in the fall, winter or spring, before the small grain is sown. Barley is the best crop when hardy weeds are to be subdued. It comes off early, and this gives the clover a better chance to outgrow, and overtop the weeds. "Timothy" and all the speargrasses let in weeds. Red clover should be sown, when the destruction of them is a material object. The close shade formed by that plant when a sufficiency of seed is sown smothers many weeds; and prevents many that are not destroyed from perfecting their seed. It is best to mow the clover, as the scythe when well applied destroys many weeds, when this grass is mowed in proper time. The longer it stands, the greater will be the number of the seeds of the weeds spread over the soil. If the clover must be pastured, great care should be taken to preserve a sufficiency of the grass, to keep the grounds always closely covered and shaded by it. Many plain, but good practical farmers, (who live where a high price for hay does not tempt them to impoverish their farms by the sale of it,) are in the excellent practice of keeping their cattle in pastures, where the clover is nearly as high as their knees; here the cattle soon fill themselves, and retire to rest in the shade; such farmers always thrive. The covering of the clover skreens the soil, and the enriching matter deposited on it by the atmosphere, and also the leaves, &c. dropped by the growing plants, from the injurious action of the sun and air; it also smothers many weeds. When this vegetation is ploughed under the ground, either for fallow crops, or for crops of small grain, the product is generally greatly increased by this very judicious mode of management. If, however, these farmers would not turn up the sod, either in the cultivation of the fallow crop, or in the cultivation for the small grain following it, they would find that both these crops did not exhaust the soil more, if as much, as a single crop of corn, or of any other strong and vigorous plant cultivated in the usual way: also, that the product of both crops would be much greater, than if the small grain had followed the fallow crop in the usual way, and that weeds would be far better subdued.

A spring crop of small grain is vastly preferable to a crop of the same description sown in the fall, when the destruction of weeds

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is a material object, and should always be employed for that purpose. I have not, however, found garlic difficult to be subdued by the first round of crops; so far, that neither the flower from the grain, nor the milk and butter from the cows, were perceptibly injured by it; when wheat sown in the fall followed the fallow crop, and a sufficiency of red clover seed was sown on it, even when the grounds were cultivated in the usual way. It has, however, been my practice never to spare cultivation, when it was believed, that the fallow crop would be benefited by it, and to use the hand hoe freely, where the plough and harrow could not disturb the weeds. Also, not to suffer my grounds to continue longer than three years in grass. It is true the weeds are not generally as effectually subdued, as we might wish them to be, by the first round of crops, be the cultivation what it may. Some of them are very hardy, and the seeds have been accumulating for ages, with but too little attention given to the destruction of them. Still every round of crops lessens their number. Why then should farmers complain? especially as while they continue to annoy us, (more than we would wish,) valuable nutriment may be readily obtained from them, for the growth of the plants, that are justly much more highly esteemed by us.

Notwithstanding the President, and too many other gentlemen, say, it is probable, that "peas give to the soil a balance beyond their receipts from it;" practice in their gardens (if no where else) ought to have taught them better than this. Many plants are called ameliorating, but every plant exhausts the soil, if its product be removed from it. Some plants require more nutriment from the ground than others; those that require the least from it, and obtain the most from the atmosphere, among which peas are properly enumerated, may be justly called lenient plants; this term is descriptive of the properties of the plant, and expressive of what really takes place in the soil. But to ameliorate is to make better, and the soil, in place of being enriched by any plant that is grown on it, is made poorer, if the product be removed. If, however, it be applied as manure, every plant, not excepting the President's "pests," becomes ameliorating. Still it is reasonable to believe, that those which shade the soil closely, or draw the greatest proportion of their support from the atmosphere, or from below the range of the roots of plants in general, or that will live and prosper on the least nutriment, will be the most enriching to the soil on which they are grown, when applied as manure for it: provided, they are as well stored with nutritive matter, as plants that are more exhausting than they are. As red clover seems to possess all these valuable properties in a greater degree than any other plant generally cultivated by us; and luxuriant crops of this grass are readily excited, by the proper use of gypsum with but little expense, almost any soil may be soon enriched or ameliorated by this invaluable plant.

It is evident Mr. Peters acted as if he could not depend either

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on the lime, or the "ameliorating" properties of the peas, to furnish sufficient nutriment for the wheat; he applied dung for that crop, and in doing this, he acted wisely. For much of the animal and vegetable matter had been destroyed by the very injudicious cultivation of the corn crop, and the lime decomposed a great part of the remainder for the peas.

This gentleman's course of cultivated crops procrastinated the sowing of grass seeds too long, unless the soil was much richer than it seems to have been; the sooner the grass seeds are sown, the sooner the grounds are filled with the roots of the grasses, than which nothing (except farm yard or other rich manure) seems so effectually to counteract the exhausting effects of cultivated crops: especially, when the succeeding cultivation of the grounds be calculated to save the nutriment arising from the roots of the grass from useless waste. When the roots alone are used for manure, they cost neither labour nor money, and when the tops are applied with the roots, the cost is much less than that of any other manure equally enriching. Green crops grown for the express purpose of manure, are considered cheaper by far, than the same quantity of nutriment for plants that could be obtained in any other way. How much cheaper must be the tops and roots of the grasses, which have cost no labour except sowing the seed, and it would seem that this labour, as well as the cost of the seed, has been amply remunerated before the grasses are applied for manure. There is no question with me that, when the very superior value of the roots of the grasses are estimated, the manure from a crop of grass ploughed under the soil, far exceeds in value that obtained from any other green crop generally cultivated for that purpose.

Some remarks on what Judge Peters says, of the destruction of the May weed is considered useful, especially as the subject seems to be introduced for the express purpose of frightening farmers, by a long string of "terrific" words, from the practice of using fresh muck, even if "necessity" should urge them to do it.

This gentleman says, in the midst of his observations on the destructive properties of "hot muck," "three years ago, I used, from necessity, unrotted litter for potatoes. I was *punished* for my *aberration* by a *most terrific* and *profuse* growth of the May weed or daisy; the seeds whereof had been among the muck. I am *scourged* by the *vile* and exhausting *pest* like a *slave flagellated* by his *driver*. I *revolt*; and my *hatred* is increased by every repetition of the *lash*. This season I *sacrificed* a fine sod of timothy and clover, *infested* by the daisy, which I have ploughed under with another potato crop; with this I shall defeat the foe, attacked before becoming a veteran."*

The muck could not have generated the seeds of the May weed; they must have been mixed with the food or litter provided for the cattle. Of consequence were the product of the President's farm,

* See Mem. Philad. Agr. Soc. vol. iii. page 234.

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which (notwithstanding he tells us that the seeds of weeds are destroyed by rotting the dung) seems to be overrun by various "vile exhausting pests," or more properly speaking, by plants which are the companions of poverty and a bad system of cultivation. What I have already quoted from his communications in the second and third volume of the Memoirs, determines that four of his fields were overrun with the "pests." These, if my memory be correct, are all he speaks of cultivating. Whether the remainder of his grounds were or were not in the same condition is unknown to me. It, however, seems probable that as they were subjected to the same management there was but little difference in the whole. Now if decomposing the dung kills the seeds of the "pests," how does it happen that the President's farm (after his practice of near half a century,) seems to be overrun with weeds, when we do not hear the "hot muck farmers" complaining of "pests;" although but few if any or them have resided any thing like so long on one farm as he has?

But what puzzles me most, is how it was possible for a fine sod of timothy and clover, and "a most *terrific* and profuse growth of the May weed," both to exist together on the same soil, for the one seems to be as much opposed to the other as light is to darkness.

I have before assigned reasons why potatoes are one of the worst fallow crops that can be grown with a view to the destruction of weeds, and as the President says, "I cannot subdue" "this vile exhausting pest" without great exertions; and even with them not entirely, unless I hand weed;"* it seems strange that he should expect to defeat this "terrific foe" "by turning under the sod with a potato crop." The May weed blossoms early, and the plants that sprang up among the small grain which followed the first potato crop, no question spread a profuse quantity of the seed of this "pest" over the timothy and clover lay. When this sod was ploughed under with "another potato crop," and the plants earthed up, these seed were buried under the ridges beyond the power of vegetation. There they lay torpid until the crop, was gathered; and were then spread abroad, as if sown to produce another crop of "pests."

If a proper fallow crop had been selected, and superficially cultivated, all the seeds of the May weed that were buried beyond the power of vegetation by turning up the sod, would have remained undisturbed; and of course torpid. Those lying near enough to the surface of the soil to grow, would not have been turned deeper under it; and after they had vegetated would have been destroyed by the cultivation of the fallow crop, and by the superficial preparation of the soil, for the small grain following it.

Mr. Peters says, that "the violent and outrageous operations of fresh and hot muck, (acting as well on the *pest* it brings along with it, as on the crop it is intended to stimulate and nourish,) are as

* See Mem. Philad. Agr. Soc. vol. iii. page 234.

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ungovernable, and often as *morbid*, *exhausting* and *mischievous* as the *unrestrained*, though temporarily *potent exertions* of one making *infuriated* and *desultory efforts*, under *paroxysms* of a *fever*. Sometimes its *fury* is spent on itself."* Also, that "the *violent* operations of hot muck, *burst* the *vessels* of most valuable plants," and "produce in grain crops, smut, blight, and mildew.† Likewise that "when the superabundant *azote*, and *poisonous* qualities of muck escape, the residuum is more than worth the whole mass." And that "fermenting muck infects the ground with a *durably deleterious taint*, instead of fertilizing it with wholesome capacities."‡ Also that "a strawy muck is frequently applied for potato crops, and the *myriads* of mice and moles infesting them are fatally known."§

Here I beg leave to observe, that neither a long string of technical terms, nor words put together in any way, can alter facts, or change the nature of things. This gentleman must have known before he put these words together, that we are not bound to believe any thing which is not supported by sufficient evidence; especially if it seems to be opposed to nature, reason and common sense. Therefore he ought to have informed us how we might observe, that the operations of fresh muck were "*violent* and *outrageous*," acting as well on the *pests* it brings along with it, as on the crop it is intended to stimulate and nourish." Also, how we may discover that these "operations of fresh muck" are as "*ungovernable*, *morbid*, *exhausting* and *mischievous* as the *unrestrained*, though *temporarily potent exertions* of one making *infuriated* and *desultory efforts* under the *paroxysms* of a *fever*." And how it happens that "sometimes its *fury* is spent on itself." He ought likewise to have informed us, whether its action on the *pests* "stimulates and nourishes" them, while it "poisons" and spreads destruction in the crop, for this seems to be implied. Also, how it happens that fresh muck, (which must contain all the enriching properties of the dung,) exhausts the land: especially when all its nutritive contents seem to be secured by ploughing it under the soil. Likewise, how we may discover the "*azote* and *poisonous* qualities of muck, that *infects* the ground with a durably *deleterious* taint, instead of fertilizing it with wholesome capacities." For although but few if any of the "fresh and hot muck farmers," claim the experience of so long a practice as does the President, it would seem that, if any of those evils actually existed, their practice must have been sufficient to discover at least some appearance of them.

Mr. M'Mahon, in his book on Gardening, recommends forming hot beds with fresh dung, from two to four feet deep; but says nothing of the "bursting of the vessels," even of the most delicate plants. When speaking of the application of fresh dung, for the growth of plants in the usual way, he tells us it becomes a dryish wisp, incapable of affording nourishment to plants.

* See Mem. Philad. Agr. Soc. vol. iii. pages 221 and 222.
† Idem, page 223. ‡ Idem, pages 231 and 233. § Idem, page 222.

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Both these gentlemen claim long practical information. Still as they are immediately opposed to each other, both cannot be right. But as it commonly happens, the truth lies between those wide extremes. Fresh dung applied in the usual way, for the growth of plants, does not become a dryish wisp; on the contrary it is gradually decomposed, and affords double the quantity of nutriment for plants, that is obtained from it, after it has been rotted or decomposed. When the litter, that may be readily obtained from a well managed farm, is carefully and properly used, the quantity of manure made by this very profitable practice is greatly increased. Fresh dung is, however, so far from acting violently, or bursting the vessels of the most delicate plants, that it acts quite as mildly as decomposed dung, whether it be or be not incorporated with litter. The quantity, in either case, may be readily so ordered, that vegetation will not be injured by an excess of nutriment or heat.

Still, if I were to grow a wager crop of maize, or any other plant that is not readily injured by a powerful application of manure, dung in a very high state of fermentation, and partially decomposed, would be greatly preferred by me. It would act more powerfully than fresh muck in the beginning, and enough of it would perfect the crop. This is, however, no reason why a farmer, (who ought to have a succession of crops and the improvement of his soil in view,) should adopt this wasteful practice, or that of decomposing his dung, until the greater part of its nutritive properties is scattered in the air.

If the cause of the "mildew" has been pointed out, it seems not to be known, or distinguished, from the many mistaken causes, which are said to produce this destructive effect. It is, however, evident that the cause, (be it what it may,) is vastly more prevalent some years than it is in others. It would also seem that some situations are more subject to this disease than others. Perhaps none so much as grounds that lie low; especially if rivers or creeks pass by or near to them. Still the effects seem to be the same, whether fresh or decomposed dung be used. Also, when enriching manure of no kind has been applied.

"Smut" seems to prevail most in our back settlements, where the country is but partially opened or cleared from its wood: also, in climates where an unusual portion of moisture prevails. It does not, however, appear to be increased either by the application of fresh or decomposed dung, or by the soil being rich or poor.

Different diseases are termed "blights," therefore I do not know the one to which the President alludes; but so far as my observation extends, no disease to which grain crops are subject seems to be even augmented by the application of either fresh or decomposed dung, or enriching manure of any description.

If myriads of mice and moles infest potato crops, when strawy muck is used, it seems strange that farmers should generally apply this kind of manure for potatoes. It is also observable that neither the rats nor the mice which infest our buildings, nor any of the

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quadrupeds which pillage our fields, seem to be fond of this root. However, as moles and ground mice will feed on it, where nothing that suits them better is to be had, there can be but little doubt that, (whether fresh or decomposed dung be applied,) the injury done by them will be "fatally known," if they should ever happen to exist in such large numbers as the President mentions.

In fact, this gentleman's assertions seem to have been made without considering either practical or chemical facts. He says that "when the superabundant *azote* and *poisonous* qualities of the muck escape, the residuum is more than worth the whole mass." The "poisonous qualities," like "infuriated," "unrestrained," &c. are, (when used to explain the properties of dung,) vague expressions; therefore, what is meant by them cannot be certainly understood. It is, however, otherwise with "azote," and of this Sir H. Davy certainly did not find any in dung. In the detail of his experiments on "hot fermenting manure, consisting principally of litter and dung of cattle," he says he found "some azote, probably no more than existed in the common air in the receiver." This gentleman also wisely remarks, that "the doctrine of the proper application of manures from organized substances, offers an illustration of an important part of the economy of nature, and the happy order in which it is arranged."

"The death and decay of animal substances tend to resolve organized forms into chemical constituents; and the pernicious effluvia disengaged in the process seem to point out the propriety of burying them in the soil, where they are fitted to become the food of vegetables. The fermentation and putrefaction of organized substances in the free atmosphere, are noxious processes; beneath the surface of the ground they are salutary operations. In this case the food of plants is prepared where it can be used; and that which would offend the senses and injure the health, if exposed, is converted by gradual processes into forms of beauty and usefulness; the fœtid gas is rendered a constituent of the aroma of the flower, and what might be poison, becomes nourishment to animals and to man."*

But Mr. Peters's practice is immmediately opposed to this very rational theory; he says, "the dreams or the labours of alchemists certainly never realized, if they have imagined, so much treasure by transmutation, as well managed stercoraries are capable of producing. But removing from them prematurely the foundation of their utility, is at once blowing out the furnace."†

Attaching so much consequence to this destructive furnace, seems to be transferring the dreams or the labours of alchemists to the stercorary, or dunghill. It, however, furnishes a very proper name for this consuming evaporator. It seems to be the principal cause why this gentleman is continually "scourged," "flagellated," "lash-

* See his Lec. on Agr Chem. pages 308, 309.
† See Mem. of the Philad. Agr. Soc. vol. iii. page 226.

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ed," and "driven like a slave," by some "vile exhausting pest," for he purifies his dung in this furnace, from "the (supposed) superabundant azote and poisonous qualities of the muck," which "infect the ground with a durably deleterious taint, instead of fertilizing it with wholesome capacities." In doing of this the greater part of the nutriment contained in the manure, is destroyed before it is believed to be sufficiently refined: consequently, the soil is exhausted, by being robbed of at least one-half of the enriching matter contained in the dung. This, of course, produces "wholesome capacities" for the growth of such weeds as are the "companions of poverty;" for they are not rooted out or opposed by plants that cannot exist or prosper on a poor soil. He says of garlic, "I always believed it to be a spontaneous native product, the companion, if not the offspring, of poverty;" and when speaking of the destruction of it, says, "my experience, for more than forty years, has convinced me that early ploughing in the spring, and most especially if succeeded by fall ploughing, is the remedy."* We also find that in 1807 and 1808 he was busily engaged in the destruction of garlic; and from that time until the third volume of the Memoirs is published, he is actively employed in the destruction of it and other "pests," notwithstanding he tells us that he had before "cleared many a field of garlic," but that in three years, (often in two,) the seed vegetated, and produced a new crop of "pests."† The seeds of weeds will vegetate, (especially in grounds that have been overrun with them,) unless the order of nature be altered to meet the inconsiderate wishes of man. If they, however, "produce a new crop of pests," to an extent that is materially injurious, it must proceed either from neglecting the cultivation of the grounds too long, or from a system of management that is better calculated to impoverish than enrich the soil. Now, certainly, rotting the dung before it is used, and exposing the animal and vegetable matter contained in the soil to useless waste, by an injudicious cultivation, is well calculated to produce this ruinous effect.

* See Mem. of the Philad. Agr. Soc. vol. ii. page 122. † Idem, page 128.

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CHAPTER XIII.

The practice of ploughing from and to plants considered, and its injurious effects explained. The expanding force of fermentation cannot be powerful where a sufficiency of animal or vegetable matter does not obtain. Of the marked fertility arising from ploughing in buckwheat, or turning up a clover lay from a wheat crop. The depth of ploughing should be in proportion to the animal and vegetable matter contained in the soil.

PLOUGHING from and to fallow plants has been highly recommended, by gentlemen of the first agricultural talent. It is said to be still extensively practised in England, by the most enlightened agriculturists in that country. Names may, and too often have, the power to sanction and perpetuate error. They cannot, however, change the nature of things, or make any practice right, if it be opposed to nature and common sense.

Doctor Anderson advocated this practice, and furnished an engraving of the lines, by which this mode of cultivation might be executed in the most ingenious way. His plan turns the soil to the plants on one side of each row, and from them, on the other side of it. As the ploughing is reversed, every time the crop is cultivated, the roots of the plants are alternately cut off, and left exposed on one side of the row; they are by this means always covered, on one or the other side of each row, therefore, this gentleman's practice is not quite as much opposed to nature and reason, as Mr. Bordley's. He recommended ploughing from the plants, on both sides of the rows, in the same cultivation. This gentleman says, "observing much irregularity in the standing of maize in rows, I caused the seed to be placed close to the land side of the furrows; the maize thus grew very straight in lines, and admitted the plough to pass near the plants. These being up, and a little grown, the design was formed of directing the finger like roots to dip deeper than common before the lateral roots should strike out. The soil was ploughed five inches deep, and turned at the first ploughing from the maize, on both sides of the plants: but they then being young, it was necessary to leave more shoulder or bed to them than was desired, to avoid burying them with the earth falling back; therefore, the plough, on having worked through the field, immediately returned to the place where it began to plough from the plants, and it now took off as much more earth, still turning it from them, on each side, as they could well bear without danger of tottering." This is a tedious piece of business, as are most other things opposed to the economy of nature, and to common sense. But to proceed, "All now rested ten or twelve days, even in the driest weather,

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with intention that the lateral roots should take their direction under the artificial surface of the ground formed by the ploughshare. The ploughs next turned a furrow, on each side of the rows, to the plants, through the whole field; and then ploughed through the balks, or the whole of the intervals not before ploughed; and so repeatedly continued to plough through the intervals from and to the plants. The alternate ploughings from and to were continued, even during the forming and filling of the grain, and it was continual work for the ploughs, in which the ploughshare passed rather over the roots, which spread and ran deeper than if they had taken their first start under the common surface of the earth, and therefore they were not torn up, or the plants fired or checked in their growth."*

Mr. Bordley ploughed from each side of the rows of the plants five inches deep, while the plants are young; he then let them rest ten or twelve days on the narrow ridges formed by this practice; this was done, that "the lateral roots should take their direction under the artificial surface of the ground formed by the ploughshare. If the corn plant, when scarcely three inches high, be pulled up by the roots from an open free soil, the lateral roots will be found about twelve inches long, beside what remains in the ground; consequently these roots are cut off on each side of the rows, even by the first cultivation, while the plant is yet very young; they are also cut off by every succeeding cultivation. If the furrows made along each side of the rows, by the first cultivation, were kept continually open, and the lateral roots of the plants compelled by this means to cross the bottom of them, a little within the ground, this would not cause the roots to grow under the artificial surface of the ground formed by the ploughshare." Nature immediately after they passed the open furrow, would direct them up into the soil above, to take their natural range through it: especially in that part of it, where the most genial heat and nutriment obtained. This is clearly seen when the lateral roots of trees cross ditches, or even deep gullies, at the bottom of them, a little within the ground. They immediately mount upward after they have crossed the bottom of the ditch, and take their natural growth at the same distance from the surface of the soil, as would have happened, if they had met with no obstacles in getting into it.

The roots of the corn plant which proceed downward from the stalk, also those that take their course along the rows, are not injured; neither are all those which grow the deepest within the soil in the intervals cut off. Therefore as the corn plant is very hardy, it is supported by these roots, until nature repairs the damage done by this truly inconsiderate and barbarian practice. It is of consequence by no means wonderful, that Mr. Bordley, who was in many respects a judicious farmer, should by his general good management, so far counteract the evils arising from this savage prac-

* See his book on Husbandry, pages 101, 102, 103.

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tice, as to grow, under all the disadvantages resulting from it, crops that were more than equal to the general crops of his neighbours. Reason, however, as well as practice, determines that crops obtained in this way must fall very far short of those that may be obtained from a rational system of management. It is also obvious, that his mode of cultivation is well calculated to cause an extensive, useless waste of the animal and vegetable matter contained in the soil. Likewise of the farm yard manure, if that be applied for the growth of the crop.

Respect for Mr. Bordley's opinion induced me to try his practice. The cutting of the roots of plants, (as might and ought to have been expected,) is very injurious to the crop; the more so, as it exposes that part of them which remains attached to the stalk, to the injurious effects of the sun and air, admitted by leaving the furrows next to the plants open. Fermentation is also much checked, by frequently turning up the soil, and admitting too much air; and the decomposed matter arising from it is subjected to the useless waste that has been before described.

The undecayed vegetable substances are dragged up by the harrow into heaps, where they perish on the surface of the soil, and do but little good to it.

Reason, if it had been properly consulted, would have been sufficient to convince me, that cutting the roots of plants, was in itself an irrational practice; still I tried Doctor Anderson's mode of cultivation; this cuts the roots, also leaves them, either on one or the other side of the rows, exposed to the injurious effects of the sun and air, until he tells us the plants ought to be earthed up. However, one trial of this very plausible, pulverising system, (perhaps formed in the Doctor's closet, was sufficient to convince me, that the roots of plants ought not to be cut in any way, even while they were young: also, that it was irrational to turn the earth away from them, especially as nature had constructed them to grow in it.

Some cultivators, in order to make the soil open and mellow, turn it from the plants into the first cultivation, but after harrowing well, turn it immediately back to them, least injury might be done by leaving the roots exposed. This is a more rational practice than either of those just mentioned, but it is laborious and also imposing. The open texture of the soil is obtained at the expense of the roots of the plants and the useless waste of the animal and vegetable matter contained in it. As fermentation is greatly checked by this practice, the soil (unless it be sandy or very rich,) settles, and becomes harder than it would have been, if the grounds had not been so carefully pulverised; especially if heavy rains follow this inconsiderate and laborious practice.

It should, however, be recollected that the powerfully expanding force of fermentation, cannot exist in a soil where perpetual ploughing and cropping has destroyed too much of the animal and vegetable matter that had formerly existed in it. In this case a sufficiency of vegetation ought to be introduced, by red clover and the

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use of gypsum. Or if the grounds have been so often excited by that substance that it will no longer cause good crops of this grass to grow on them, without the aid of enriching manure, such other plants as the soil will grow, should be cultivated and ploughed under for manure. When as much vegetation is procured from an exhausted soil as it is capable of producing, and also as much animal matter as may be obtained from the cattle grazed on it, and the animalcula which are fed and sheltered by it, the next thing to be considered is, how this scanty product may be most advantageously used, and with the least possible expense. The quantity of inert earth is often very great in proportion to the animal and vegetable matter derived from the green crop grown on it: therefore but little comparative good is to be expected, unless this manure be so applied and ordered, that the whole expanding force and enriching matter contained in it, be expanded within the soil to the best advantage. However, if this be done, the benefit derived from it will be found much greater, than has been commonly obtained from ploughing green crops under the soil, for the growth of fallow crops.

To illustrate this I will again refer to buckwheat. That plant is too often threshed on the field where it grew, and the straw left in large heaps to perish, with but little ultimate use to the cultivator. We may observe, after the straw has been decomposed, that the remaining matter is very little, when compared with the original bulk of the heaps. This together with the evident texture of the straw, seems to determine that water forms a very considerable proportion of the plant. It of consequence contains much less nutritive matter, than most of the plants ploughed under the soil for manure. It has, however, notwithstanding this, been ploughed under with very great success, for a wheat crop; especially in England. Now we all know that although the wheat will stubble, fall, and become unproductive, when too much manure is applied for the crops, still much nutriment is required to grow a good crop of that grain. Why then does a crop of buckwheat ploughed under the soil supply sufficient nutriment to effect this purpose, when it clearly appears to furnish but little nutritive matter for the growth of plants? The reason is obvious, and the principle highly important to the interests of agriculture, if farmers would make a general and proper application of it. After the buckwheat is ploughed under the soil, it remains undisturbed by folly, and the injurious and very expensive labour too generally used when fallow crops are cultivated: consequently fermentation keeps the soil open and mellow for the roots of the plants, and decomposition supplies them with nutriment. As none of the enriching and fertilizing matter, arising from the decomposition of the green crop, is uselessly wasted in the way that has been described, the product is as abundant as could be rationally expected from the properties of the manure. It therefore seems, that quite as much, (if not more) depends on the proper use of manure, as on the quality or quantity applied; especially as we all know that a clover lay is an excellent preparation for wheat. If

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the ground be well stored with the roots of this plant, the crop seldom fails to be productive, even when the soil is thin, provided the seed for the grain crop be sown on one ploughing. On the contrary, if the lay be prepared by repeated ploughings, the crop is seldom good, unless the soil be rich enough to supply the great loss sustained in consequence of exposing the enriching and fertilizing matter contained in the clover roots to useless waste. This fact has been often and well confirmed, by sowing one part of the same clover lay on one ploughing, and the other part after the grounds had been oftener ploughed. Although the cause of this marked difference ought to be known, it certainly has not been sufficiently considered: especially in the different application of clover and other grass lays, or a more general and far better application and cultivation of them would have been adopted. Gypsum, even when the soil is very thin, causes the clover to grow luxuriantly. The tops we know to be very nutritive, and have every reason to believe that the roots are not less so, as far as the food for plants may be concerned. When the clover has not been injured by being too frequently mown or closely pastured, the interior of the soil is well filled with its roots, and the surface of the ground is as regularly covered with the tops of the plant. As it cannot (like the spear-grasses,) live after its roots have been reversed by the plough, a general fermentation quickly takes place; and as this is not checked when small grain is sown on one ploughing, the crop is generally as good as might be expected from this judicious and of course rational practice.

Why then should we spend so much money in useless and very injurious labour, when it is evident, so far as the practice has been generally tried, that if we place the necessary materials properly within the soil, and subdue the grasses and weeds on the surface of it, by the very easy and effectual means that have been described, nature will keep the interior of the soil more open and mellow, for the growth of the plants, than can be done by us with the plough? It should be also recollected, that by the use of this instrument, we cut and rend the roots of the plants, and by turning up the nutritive matter, expose it to much useless waste.

It is, however, considered proper to remark, that notwithstanding it clearly appears from the practice of turning a clover lay, and ploughing in buckwheat for a crop of small grain, that but little nutriment will produce surprising effects when it is properly ordered, still the amount of the green crop ought to be sufficient to keep the earth open and mellow. This being the case, it is evident that a thin soil should not be ploughed deep, when the vegetation is turned under it, unless a sufficiency of farm yard, or other enriching manure, be added, to keep the soil open and mellow, or the ground, below the usual depth of ploughing, is found to be richer than the soil which has heretofore been employed. This last I have never seen, neither can it happen, except in soils originally very deep, but so long ploughed and severely cropped, that the upper

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part of them has been exhausted. The idea of bettering or enriching poor soils generally, by deep ploughing, and exposing the inert earth to the enriching influence of the atmosphere, is certainly very erroneous.

The poor inert earth, thus exposed, will imbibe some enriching matter from this source: still, it will be much less than if the grounds had not been deeply ploughed. Such a large body of inert matter cannot be kept open and mellow by the fermentation of the green crop grown on the grounds. Covering this vegetation so deeply under the thin soil and inert earth, will greatly retard the fermentation of it. It is evident that plants grown on this bulky and inactive mass of matter, cannot be sufficiently luxuriant, either to gather, or secure by their shade, any thing like as much nutriment from the atmosphere, as would be obtained from it if the depth of the ploughing were calculated to suit the depth of the soil. In the latter case, the quantity of inert earth would be so much less, that the fermentation of the green crop would be sufficient to keep the soil open and mellow. The roots of the plants will also soon penetrate the decaying sod, where they will find sufficient nutriment to cause them to grow as luxuriantly, as might be reasonably expected from the means employed. Healthy, vigorous plants require and obtain much more nutriment from the atmosphere than feeble ones. They also far better defend, by their more extensive shade, the enriching matter that has been deposited on the soil, in the way that has been before described. The better crops will also furnish much more offal vegetation for litter. The grasses following them will be much more luxuriant: consequently, the shallow ploughing will return much more enriching matter to the soil. This will enable the cultivator to plough something deeper at the commencement of every succeeding round of crops, until any reasonable depth of ploughing may be performed, without doing injury either to the crops or the soil.

Some gentlemen urge, that turning up the inert earth by trench ploughing ameliorates it. They ought, however, to have considered, before they recommended this very injurious practice, that this amelioration is principally effected at the expense of the enriching matter contained in the soil above. By ploughing and harrowing it is always more or less mixed with the poor earth turned up from below it. This spreads the fertilizing matter contained in the soil thinner, or wider apart: consequently, causes fermentation and decomposition to act much more feebly, and to progress much slower than if this matter lay closer together.

Mr. Bordley says, he has "stripped the blades and cut off the tops when the corn was nearly soft enough for roasting ears;" and that "no difference was observed between this and the rest."* If this gentleman had measured the product, he would have seen a marked difference.

* See his book on Husbandry.

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It was discovered early in August, 1810, that proper grasses for soiling my cattle would soon be very deficient; and on the 20th of that month one row of corn, in a field of thirteen acres, was topped, to ascertain how the plant would bear early cutting. It was thought that it had received no injury. On the 31st of the same month I commenced feeding the cattle with the tops cut daily, as wanted. These lasted them until the 18th of September. After this the blades were stripped, commencing where the topping began. They fed the cattle until the 5th of October.

In the process of topping and blading, one row was left entire, standing between the row which had been topped on the 20th of August, and another row that was topped on the 2d of September. These three rows were cut off by the roots on the 2d of October, and hauled in and set up separately under my own inspection. They were husked and measured on the 8th of November.

Produce of the row that had not been topped and stripped, nine bushels and five-eighths of corn in the ear.

One of the rows which had been topped and stripped, measured seven bushels and six-eighths; and the other topped and stripped row measured seven bushels and three-eighths of corn in the ear.

Thus it clearly appears that mutilating the corn plant before its fruit is perfected, is a very injurious practice. The injury done to my crop by this mode of management was clearly seen some time before the three experimental rows were cut off. Throughout the whole field the husks were generally dry and open, except on the row which had not been topped and stripped. On this, they still retained a greenish hue, and were close set to the ear when the plants were cut off by the roots.

In 1811 I selected three rows of maize in the middle of my field, as nearly alike as possible. The plants were then about two feet high. I cut off the tops of the middle row as low down as might be readily done without injuring the tassels, which were wrapped in their own leaves within the stalks. I could not observe that the stalks, in the row which had been cut, grew any thicker, until new leaves had been formed from the crown of the plants. Before this happened, the stalks in the rows on either side of it, seemed to be as thick again as those standing in it; and the ears grown on the plants in this row shot, filled, and ripened, about two weeks later than the rest of the field.

As several writers on agriculture had asserted that the tops of potatoes might be cut and given to the cattle, without injury to the crop, I cut off the tops from a row running through the middle of a very luxuriant patch. Care was taken to cut them in that way which was supposed least likely to prove injurious to the future growth of the plants. The debilitated appearance of the second growth of the tops, determined me not to risk a second cutting of them. When the crop was gathered, the roots in the row that had been cut did not seem to be more than half as large as those in the rest of the patch.

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In fact, I have never seen any advantage arise, either from carefully trimming, or ruggedly mutilating, annual plants; on the contrary, much injury certainly follows. It is, however, probable, that good housewives and ignorant gardeners will continue to tread and mutilate the tops of their onions, as long as the world may happen to last, for the express purpose of making the roots grow much more luxuriantly; unless, perchance, they may happen to reflect, that the tops would not have existed, if nature did not consider them as necessary to the well being of the plant as its roots. Certain it is, that the writings of many gentlemen, who ought to have known better, are exactly calculated to confirm them in this truly savage practice.

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CHAPTER XIV.

Very luxuriant crops too seldom determine good management. The error of too close planting exposed. Ridges produce artificial drought. The evils arising from old grass grounds pointed out. Many and highly important advantages are to be obtained by sowing grass seed separately. The plough, in the hands of the inconsiderate cultivator, speedily exhausts the soil. When this instrument is properly used, it greatly hastens the improvement of it. Convertible husbandry is the most profitable practice, where population and capital prevail. A more extensive attention to grass and rearing live stock suits our back-woods settlements best.

As the glare of large crops frequently misleads, and induces too many cultivators to adopt bad practices, it may be proper to show, that great product is so far from being always the result of an enlightened practice, that it has been often obtained when the management has been excessively bad.

Mr. Stevens's wager crop of one hundred and eighteen bushels of corn to the acre, published in the Domestic Encyclopædia, is the largest product that I have noticed. He introduced 26,880 plants to the acre, in double rows, with intervals of five feet six inches: this is fifty-six plants in the length of one perch along the rows. A large ear, shells one pint of corn; moderate sized ears will measure more than half a pint. If each plant in this gentleman's field had produced only half a pint of shelled corn, his crop would have yielded about two hundred bushels to the acre: consequently the number of the plants greatly injured the product of it. There can be but little doubt, that if Mr. Stevens had suffered only thirty-three plants to stand in the length of one perch on the rows, that his soil, heavy manuring, and attentive cultivation, would have grown a much larger crop of corn. For my crop of corn grown in 1815, (the cultivation of which will be hereafter described,) shows that his intervals were well calculated to favour the prosperity of the plants.

The effect of too thick planting in the rows, was clearly seen in my crop of ninety-one bushels to the acre, grown in 1811. This was grown in double rows, on ridges, half a perch asunder, planted triangularly, as was my crop of 1810, which will be next described. The number of plants, about 20,000 to the acre, or sixty-two plants in the length of one perch along the rows, was quite too many. Although the intervals were wide, they seemed filled by the plants that leaned out into them; and those plants whose tops got undermost were so much shaded, that they became entirely barren; and

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those that predominated, had the shortest ears which I had ever grown before. Still, the product was greater than that of any crop of maize grown by me. If the intervals had been narrower, and much fewer plants suffered to grow in the rows, no question but the crop would have been much more productive: for the soil was generally good, and the manuring sufficient to grow a much larger crop of corn, if the plants had been reduced in number, and better arranged on the ground.

I planted, in the spring of 1810, thirteen acres in corn and potatoes, the former on five feet and a half ridges, two rows on each ridge, intended to be twelve inches apart along the rows, and the same distance triangularly across them; but by a mistake in the construction of the indenting roller, formed to make holes for planting the seed, the distance along the rows turned out to be about fourteen inches. The holes for planting were sunk two inches and a half deep. It was intended that two plants should be left in each cluster; but as the holes were sunk entirely too deep, much of the planting failed. The field was replanted; but this, (as commonly happens, when the plants stand thick on the ground,) did more harm than good. Between the corn ridges were planted, on beds five feet six inches wide, two double rows of potatoes; vacancy between them, two feet two inches; the double rows were designed to be eight inches apart, straight, and triangular, like the double rows of corn; this left ten feet four inches between the double rows of corn for the sun and air. It was found, however, that a mistake had been also made in the construction of the indenting roller, formed for making holes for the potato sets, and that these holes were nine, in place of being eight inches apart along the rows. They were sunk only one inch and three-quarters deep; this was not half deep enough, and the crop suffered greatly in consequence of this very inconsiderate arrangement: also quite as much, or possibly more, from the plants standing entirely too thick on the ground. If single, in place of double, rows, had been planted, the product would have been considerably increased, and half the seed saved. The failure in the corn plants was considered injurious to the crop. I have, however, since been clearly convinced, that it was very advantageous to it, and would have been more so, if replanting had been omitted, except where none of the original planting succeeded, within the distance of six or more feet in the rows.

Still the produce was eight hundred and seventeen bushels of shelled corn, and one thousand seven hundred and thirty bushels of potatoes. This forms an average of two hundred and sixty-three bushels of potatoes, and one hundred and twenty-four bushels of shelled corn per acre, if I may be permitted to assign to each the ground they occupied.

My mixed crop of corn and potatoes, grown in 1810, did not discover the impropriety of close planting in the rows, as the failure in the corn plants reduced their number very considerably. But

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my mixed crop of maize and barley, grown in 1811, clearly pointed out the error of too many corn plants.

The barley was sown at the rate of three bushels to the acre on six feet beds between the ridges formed for the corn; which were also of the same width. The produce in barley at the rate of thirty-six bushels to the acre, measuring only the beds on which the barley grew; and that of the corn when shelled at the rate of one hundred and thirty-eight and a half bushels to the acre, measuring only the ridges occupied by it.

The corn certainly stood much too thick on the ground. There were about sixty-four plants within the length of one perch, planted triangularly in double rows in the same way as the corn was planted in 1810. Many of the plants were entirely barren, nubbins numerous, and the ears generally very short and badly filled: still one of the best ridges, husked and shelled under my own inspection, measured at the rate of one hundred and fifty-two and a half bushels to the acre; and another ridge ordered in the same way, measured at the rate of one hundred and forty-nine and a half bushels. Yet it was clear to me, that if half the plants had been removed, so soon as danger from grubs, &c. had passed by, much more corn would have been obtained.

What might have happened if the soil had not been too generally very thin, previously to the manuring it for the mixed crop, or a sufficiency of dung had been introduced to supply the defect, I cannot determine; but where the soil was good, evident marks of the injudicious practice of close hedge-row planting appeared.

Accident in my mixed crop of 1809, led me to expect considerable advantage from ridging for corn. I have, however, since found that it was an increased quantity of soil and manure introduced by the ploughing, that rendered the plants on the ridges, which had been accidentally formed, much better than the rest of the field; and not as was believed, the concentrating a double quantity of soil and manure immediately under them. Also, that ridges, unless the seasons are uncommonly dripping, are very injurious. They produce artificial droughts, by too speedily running off the rains into the cleaning out furrows, through which the water too quickly passes off from the field: consequently, the interior of the soil is very often found dry, immediately after sufficient rain had fallen to water the soil plentifully, if it had not been run off by the ridges and furrows.

Ridging up, and too close planting, were not, however, all the evils to which my ill fated crops were exposed. The roots of the plants were also cut off and mangled; the manure, together with the roots of the grass, exposed to useless waste, by the inconsiderate and savage practice of cultivating the corn and potatoes with the plough.

The investigation of the ordering of these crops, clearly demonstrates, that large product does not always determine judicious management. Also, that if cultivators would carefully observe the progress of their crops, and candidly publish their errors, with the publication of the management and result; those errors, instead of

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being copied, and perpetuated by others, would be avoided, and the knowledge of agriculture greatly increased.

Slovens seldom injure agriculture further than their own practice extends. Those who wish to improve do not imitate them, unless perchance they actually discover something that is interesting in their mode of management. But enterprising cultivators, who possess sufficient capital to favour their plans, frequently grow productive crops, when that part of their practice which is considered most interesting by them, is not only bad, but also extensively injurious. When their crops are published, farmers who wish to improve, too generally believe, (without sufficient investigation,) that the successful means employed in the growth of them, must be the best that can be used to obtain the same end. And as new practices and new seeds are commonly favoured with the best soil and cultivation, they become popular, and too frequently circulate extensively to the great injury of agriculture.

The next and last erroneous practice to be at this time considered, and contrasted with a better mode of management, is an increasing partiality for old grass grounds.

The extensive improvements in the agriculture of Great Britain, have excited our attention; but they have also induced us to adopt too many of their errors in practice. Among which we may include an improper estimation of the value of old grass grounds. I shall therefore endeavour to point out the mischief arising from this inconsiderate practice. Perhaps this cannot be better done, than by showing that old grass grounds are contrary to the interest of that country, where they often continue for ages unploughed.

The great advantage which the agriculture of Great Britain derives from an attention to grass, has been too generally attributed to their superior management of the grasses; when, in fact, the produce and profit of their crops are greatly diminished, in consequence of the very improper management of their grass grounds. Their grain and other cultivated crops are also vastly deficient from the same cause.

When Britons became agriculturists, the grasses which had supplied their cattle while they were shepherds were ploughed in proportion to the extent of their cultivation, until it became necessary for art to assist nature in the multiplication of their grass grounds. It is probable that at this time they introduced the injudicious practice of forming grass grounds from seeds indiscriminately gathered from haylofts, without reflecting that, by this means, they introduced late and early, good and worthless plants, with all the intermediate qualities between those wide extremes, together with innumerable weeds. If it were not that we daily see practices equally absurd and injudicious, advocated by gentlemen of talents and enterprise, it would seem strange that the present enlightened agriculturists of that country should still persist in the same mode, or with but little deviation from it; although they are frequently disappointed in accomplishing their object. It often happens that after

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much labour has been expended, and the income from their grounds either lost or greatly curtailed, they are at last indebted to nature, aided by expensive extra manurings, to cover their grounds with grasses.

The agriculture of Pennsylvania is inferior to that of Great Britain, yet there are improvements in this country worthy of more attention from Englishmen than has been given to them. Our farmers select their grass seeds from the most approved plants; no unknown mixtures are admitted, (except by slovens;) they are gathered, threshed, cleaned, and kept separate. By this means we are in possession of the best plants that have claimed our attention. We might also have known the relative value of each for the different purposes for which they are used. This has, however, been neglected, although it is probable that if it were known, half the ground which is at this time found necessary to fatten an ox would effect that purpose.

It would seem that nothing can exceed the fascinating power of public opinion to perpetuate error, and often to carry it to a ludicrous extent. This is evinced in the attachment that English farmers have for old grass grounds. Some gentlemen there, disappointed in obtaining such as would meet their approbation, have encountered the enormous expense of paring sods from lanes, highways, &c. and covering their fields with them. Although this expense was but a part of the evil introduced by this irrational practice, as sods, procured in this way, must be well stored with weeds. However, these may be pulled up by the roots, when money is so plenty as to enable the cultivator to form grass grounds with sods.

Other gentlemen in England are so infatuated with the ideal value of old grass grounds, that they will not suffer them to be subjected to a rational cultivation when overrun with moss, and other worthless vegetation. Although several of their enterprising countrymen have effected astonishing improvements in grounds of this description, in a very short time, by subjecting them to the plough, and returning them again to grass.

The plough, in the hands of an inconsiderate farmer, may be justly considered an instrument of certain and speedy destruction. It not only excites the soil to fertility, but also, by being improperly used, turns up and exposes the animal and vegetable matter contained in it to much useless waste; and as little, if any thing, is returned by such cultivators to the soil, the loss of the nutriment necessary for the growth of the crops, together with the useless waste introduced by a bad system of husbandry, very rapidly exhausts and impoverishes the grounds.

Still, when the plough is properly used, it is the only means by which a speedy improvement can be made, without the aid of extraneous enriching manure. The cause is evident; for when the soil is properly cultivated, the plants are as healthy and vigorous as it is capable of producing. This enables their roots to dip deep, and

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spread wide through it, in search of nutriment. The tops of the plants are also increased in proportion to the vigour of their roots, which calculates them to gather much food from the atmosphere. Also, to shield, by their extensive shade, the rich, fertilizing matter deposited by it on the surface of the soil: consequently, the vegetation is greatly increased, and that part of it which the farmer can readily spare, will, when it is judiciously returned to the land, effect an improvement far exceeding the calculation of those who have not carefully investigated this very interesting subject.

Why, then, should the enlightened and enterprising cultivators of England dread the effects of the plough? It should be laid down as a maxim in farming, that no grounds ought to be continued in grass until they become hard bound, or consolidated, and the roots become old, debilitated, and matted. Also, that a stop should be put to the plough before decaying animal and vegetable matter has been too much reduced to grow luxuriant crops of the grasses. Great crops of grass can be no longer expected than while the soil continues free and open, and the roots remain unimpaired. Neither can superior grain crops be obtained after decaying animal and vegetable matter ceases to expand, open, divide, and enrich the soil.

Rich grass grounds in the vicinities of cities and towns, where there is a demand for hay, and enriching manure can be readily procured, may be profitable as they are now managed. Still, if one-fifth of those grounds were, in regular rotation, annually cultivated in fallow crops, to be followed by wheat or other small grain, the remaining three-fifths will produce more hay and pasture than the whole, as now managed. Also, a sufficiency of manure to insure a progressive improvement of the soil, provided the cultivation and management be good.

It is wonderful that the surprising improvements effected in grass grounds comparatively worthless, have not long since introduced in England the proper management of grass grounds in general; especially as many of them are too thin to produce profitable grasses. The proper cultivation of grass grounds, with the same manure as is expended on them in top dressing, (or at most, a small additional quantity,) would procure as much, or more, and far better grasses, than can be obtained from the same grounds by the present mode of management: also, with the additional advantage of luxuriant fallow and small grain crops, in regular succession; provided the grounds were subjected to a proper system of convertible husbandry. They have been consolidated by time and the hoofs of the cattle, and are closely matted and hard bound by the innumerable roots of the grasses and weeds; many of the former are enfeebled by age, and multitudes hastening into decay. This, with a great variety of useless, as well as very injurious plants, forms a surface on which may be found the best and worst of plants, together with all the intermediate grades between those wide extremes. These spring in regular succession from early to late.

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Those evils are the natural consequences of procuring seed from haylofts: also, of age, which gives time for the native grasses and weeds to root out the better vegetation: particularly if the latter does not happen to be equally hardy and congenial with the soil and climate; and this seldom occurs, as too little attention is given to procure such as suit either.

Besides the expense which frequently attends the extirpating those hardy weeds, destroying moss, ant hills, &c. by manual labour, would go far towards cultivating the soil.

When English farmers save their seed separately, they too generally sow a variety of them on the same ground. We, also, too often do the same thing, from a mistaken idea that more grass will be mown. It seems, however, that they in general form these mixtures, that the grasses may spring in due succession for grazing, although none of those gentlemen would hire a double set of labourers, that one set might sleep while the other was working. This would be considered an expensive arrangement: so are the sleeping grasses if rent be taxed on the soil occupied by them during their inactivity. Why then resort to this irrational practice? Is there not a sufficiency of grasses that spring very early, and will when they are either pastured or mowed, grow luxuriantly until vegetation is locked up by frost? No question but there are among those kinds, such grasses as are very nutritive. These plants, while young and vigorous, and at the same time growing on an open and free soil, which is unincumbered by debilitated and decaying grasses, or hardy weeds, are unquestionably capable of producing much more and far better grass than could be procured from old grass grounds, labouring under every disadvantage but poverty. Provided the seed for the young grasses are sown sufficiently thick to produce as many plants as the soil is capable of perfecting, and such mixtures be avoided as would materially interfere with each other. When, however, it is considered that few plants ripen exactly at the same time, or maintain the same height, and that the broader spreading foliage of some of them, is injurious to those of a contrary description, it is probable that mixtures of every kind should be avoided; especially as the comparative value of the different grasses, is only to be known by growing them separately.

The properties of the grasses ought to be congenial to the soil and climate. If this be particularly attended to, the farmer will be seldom disappointed in a great sufficiency of plants to grow luxuriant crops. The principal cause of so many disappointments in procuring well set grass grounds, is either too little seed, or the introduction of such as are incompatible with the soil or climate.

Incalculable advantages may be obtained from sowing grass seeds separately. This will clearly point out the grasses best suited to our soil and climate. If such only were sown, they would generally prosper, and produce the greatest crops that the soil and climate were capable of perfecting. Instead of this, so soon as any plant becomes conspicuous for its valuable properties, it is forced into

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every soil and climate, without duly considering that but few if any plants are calculated to produce luxuriant crops every where. This seems to be the principle reason why we so often hear some cultivators extolling certain grasses while others say they are worthless.

By sowing grass seeds separately, we may discover those possessing peculiar properties for fattening cattle, and such as are the most proper for the different varieties of domesticated animals: also those best calculated to produce the largest quantity of the most nutritious hay, and such as would communicate the best flavour to butter and cheese, and at the same time form the most luxuriant and profitable pastures. In fact from this only rational practice, we may gain as intimate a knowledge of the different grasses, as of the grain and roots grown by us.

In our back countries the population is thin, and we generally have an extensive range for live stock during the summer, outside of our cleared grounds.

The navigation of too many of our rivers and creeks remains obstructed; the roads also are too generally neglected: therefore, it will be found an excellent practice in the back-woods, to multiply the grasses considerably beyond the quantity necessary for a regular convertible husbandry; and to rear live stock, until population becomes thicker, and those obstacles to a vent for our produce be generally removed; or manufactures be established in sufficient number to open a ready market for it.

But where population is thick, labour easily obtained, and a ready market for produce generally prevails, convertible husbandry will be found much more profitable. The grasses arising from this practice will be found fully sufficient to keep a stock of cattle equal to the demand for manure. The offal vegetation from the cultivated crops, together with such other vegetation as may be gathered, will with proper management, supply an abundance of litter.

In England a convertible husbandry would be still much more profitable than in this country, where a large surplus of grain for exportation generally prevails, and the least apprehension of a general scarcity of bread never occurs; unless it is feared that the high price abroad, may induce our merchants to export it in such quantities as to introduce a scarcity here. This evil, however, has not yet happened; but as it may very readily occur, the subject is an interesting one, and seems to demand more attention than has been given to it; especially when a serious failure in our crops takes place at a time when the same has generally occurred in Europe. This seems to have been the case of the present year, 1816.*

But to return. The thick set population of Britain and the extensive capital of her farmers, would certainly render the practice of convertible husbandry exceedingly lucrative to the cultivator,

* When this was written, the complaints of scarcity had excited alarm, for which no real cause generally existed, or so much provision could not have been exported from this country without injurious effects.

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and equally beneficial to the nation. If it were generally adopted, those frequent and very distressing apprehensions of a scarcity of bread, could not in the general course of events occur, until population had greatly increased.

Some gentlemen in England practice a convertible husbandry, especially in Norfolk. Their fallow crops, however, seem to be seldom if ever grown on grass lays, although they are well aware of the great value of a clover lay, (or a mixture of other grasses with it,) for wheat.

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CHAPTER XV.

Fallow crops should be grown on grass lays. The speargrasses are best for this purpose. A red clover lay is best for small grain. The texture of any soil is most advantageously altered by the roots and tops of the grasses, properly applied and ordered. The judicious application of this vegetation, will often supercede the necessity of ridging and under draining. How ridges should be formed and cultivated in retentive soils. The injury done by hilling, ridging, and moulding up plants is explained, as are also the advantages derived from a level and very superficial cultivation. It is shown that altering the present general practice of husbandry, so that every fallow crop may be superficially cultivated, can be readily done. Observations on preparing the soil for small grain, when it ought not, or cannot, be conveniently done by a fallow crop.

Much time and paper have been spent in exposing the erroneous and injurious practices generally pursued in the cultivation of the soil. However, as in doing this, I have been obliged to contrast those errors with the principles of a rational and proper cultivation, but little remains to be said on this subject, except, briefly to arrange these principles under one general head. As in doing this, I am compelled to recapitulate a great deal that has been already advanced, but few new ideas will appear in this chapter. I will commence it by observing, that the cultivator should never forget, that fallow crops ought to be invariably grown on speargrass or clover lays, whenever it can be done. This will be always practicable, after his grounds have been reduced to a proper system of management.

Both clover and speargrass lays are excellent for fallow crops; but the latter is best for this purpose, as it may be kept much longer, without danger of the grasses running out.

The roots of these grasses, when turned up for crops, seem to sink slower into decay; of course are better calculated to extend the advantages derived from them to succeeding crops: but as reversing the roots of red clover quickly and effectually kills the plant, it forms a much better lay for wheat and other small grain: especially when they are sown broad cast. When the soil is rich, or a sufficiency of enriching manure can be applied for the fallow crop, to insure a luxuriant growth of the speargrasses, they should be sown to form a lay for the ensuing crop of the same description; unless clover be sown with a view to the destruction of weeds. When the speargrasses form a lay for the fallow crop, and clover for the wheat or other small grain, a change in vegetation is intro-

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duced, which greatly favours the product of the crops.* It clearly appears from the economy of nature, as well as the practice of husbandry, that the soil becomes tired of growing the same plants too long. The cause of this is not certainly known, but it seems probable, as some plants are deficient in matters which other plants possess more abundantly, that it is by the decay of different plants, or such parts of them as are not removed, that the different fertilizing principles are best blended with the soil. As plants, as well as animals, may, to a certain extent, have the power to select such food as suits them best, this also may operate against growing the same plants on the same soil, without a proper intermediate change in vegetation.

Be this, however, as it may, it appears that a regular system of change may be readily formed, to prevent any injury of this kind, without resorting to the random changes of seed and plants, that seem to be subversive of all rational improvement. As this is a very interesting subject, the changes effected by nature have been explained in my book on Vegetation and Manures.

Grass lays, when properly applied and cultivated, are very productive, and enrich the soil far beyond what is generally supposed, or can in fact be accomplished by the usual practice. They also alter the texture of it so much, that it is capable of growing valuable crops, which were before opposed to its natural texture, and which could never have been profitably grown on it, until this alteration had been effected.

It is true, that other substances will produce this change, and the effect will be more permanent; they, however, are both bulky and weighty, and the introduction of them very expensive. Neither do they enrich the soil, except by the small portion of animal and vegetable matter that may happen to be contained in them. Whereas the grasses cost nothing but their seed, and the little labour of sowing them over the crops of small grain; and although the alteration effected by them be not so permanent, it is readily repeated; and every repetition introduces valuable manure. As the soil is never stripped of animal and vegetable matter, it will require much less farm yard manure for cultivated crops. If grasses be selected that are suitable to the soil and climate, the farmer will be but seldom disappointed by their not succeeding.

Even herdgrass, which is considered peculiarly calculated for swampy and wet grounds, has been found to succeed in light and sandy lands; consequently filled the soil with its innumerable roots. Still, to insure success, the nature of the grasses ought to be in unison with the properties of the soil. However, if herdgrass should generally succeed on sandy soils, it would be very valuable. Its roots must form a great mass of strong vegetation, or they would not be capable of supporting loaded waggons, where, before

* If the ground be sufficiently rich to grow speargrasses and farm yard manure is plenty, and these grasses suit the cultivator best, the change in vegetation may be readily effected by growing different varieties of them.

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this grass was sown, the grounds were too swampy to admit an ox or horse to pass safely through them. It is said of red top, which is a variety of this grass, that it will grow and form a sod in one year on banks where no other grass will thrive.

If nature and reason had been sufficiently consulted in the practice of husbandry, it would have been generally known, that ploughing a considerable mass of vegetation under a sandy soil, will as effectually prevent an injurious evaporation of moisture from it, as the application of any other substance commonly used for that purpose, until the vegetation is decomposed.

The fertility of rich, sandy soils also determines, that an injurious evaporation of moisture from them, is greatly retarded, even by the enriching matter arising from the decomposition of the vegetable substances while it continues in the grounds. Hence it is, that we hear but little complaint of the sandy texture of soils, until these substances, and the fertilizing matter arising from the decomposition of them, have been considerably exhausted by an injudicious husbandry. On the contrary, we find that the renters of land generally prefer sandy soils, while they continue rich; the cultivation of such grounds is far less laborious than those of a firmer texture, and may be progressing, when continued rains have put a stop to the plough in soils that are more retentive of moisture.

It is also worthy of remark, that the nutriment arising from the vegetation ploughed under the soil, will greatly promote the vigour of the plants: also, that the close shade formed by this increased vegetation, is well calculated to defend the soil from the injurious influence of the sun and air; whereas the mixture of clay, &c. with a sandy soil, merely alters the texture of it.

Many gentlemen of distinguished talents fondly imagine, that alterations made by combining the different earths properly, will effect a more productive, as well as lasting improvement, than can be made in any other way; it will be found, however, that no combination of the simple earths, without the aid of animal or vegetable matter, can create a soil calculated for the efficient growth of plants: also, that after the animal and vegetable matter contained in this improved soil, has been exhausted, it, as well as the unimproved ground, will be unproductive. Plants cannot prosper in any soil, unless a sufficiency of nutriment has been provided for them. Still it is readily granted, that a happy mixture of the different earths greatly favours vegetation; but this cannot be obtained, where nature has not formed it, without great labour and expense. No fact is more obvious in our recent settlements, than that every soil well stored with animal and vegetable matter is productive, until these substances have been too much exhausted: also, that after this evil has been effected, the fertility of the exhausted soil is restored, so soon as a sufficiency of animal and vegetable matter has been incorporated with it. Why then should we encounter the enormous labour and expense of altering the texture of our grounds, by mixing other earths with them, when we can grow luxuriant crops,

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and gradually improve all the different soils, without having recourse to this Herculean task?

The texture of stiff, retentive, clay soil, may be also as readily altered by grass lays; for, (as has been before observed,) every furrow slice forms an under drain, more especially if a good crop of grass be turned under the sod. The vegetation thus applied, more effectually cuts off the communication between the cold clay underneath and the furrow slice above: also furnishes a wider opening between the two to run off the moisture. This will frequently render ridging up useless, where it could not be dispensed with in the usual mode of cultivation; and often save the expensive practice of draining in still moister soils: provided the grounds be formed into ridges of a suitable width, and the clearing out furrows be properly regulated and cleaned out. But this is not all, for the innumerable roots of the grasses divide the soil minutely. The fermentation of them expands and opens it, and their gradual decay not only greatly enriches it, but also furnishes an inconceivable number of hollows or cavities throughout its whole extent. These openings being equal to the length, thickness, and number of the roots of the grasses and weeds, they are well calculated to admit the ready progress of the roots of the growing plants through every part of the soil. This, together with the powerfully expanding force of fermentation, and the nutritive matter obtained by decomposition, forms a light, open, artificial bed, well prepared for the growth of plants. When the soil is thus ordered, they do grow luxuriantly, and produce abundantly: provided the succeeding cultivation be calculated to secure these very obvious advantages.

I have before observed, it seldom happens that any benefit is derived from deep ploughing, even for fallow crops, when the soil is thin: also, that much injury may arise from that practice, unless a sufficiency of enriching manure be applied; as the under stratum of a poor soil is seldom calculated to promote vegetation.

If the soil be tolerably good, six inches deep will be fully sufficient; but if it be excellent, or a sufficiency of enriching manure be applied, from eight to nine inches will be found greatly preferable. Ploughing to this depth, is best done by one plough following another in the same furrow; the first plough pares off about one-third the depth, the second turns the remainder on the furrow slice formed by the first plough. If the ploughs be properly constructed to effect this purpose, you will have a beautiful clean surface, readily pulverised with the hoe and tined harrow following it; but if the soil be tolerably mellow, the tined harrow alone will be found fully sufficient to pulverise it.

It is said, the skim coulter plough will effect this depth of ploughing equally well, and with much less labour. A plate of this plough may be seen in the third volume of the Memoirs of the Philadelphia Agricultural Society.

I do not think the engraving so correctly executed, as one I have seen in some other book on agriculture; but I have forgotten

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the name of the author. I have been informed, however, by a gentleman, who was practically acquainted with this plough, that it is very difficult to get the skim properly fixed, unless it be done by those who are well acquainted with the instrument: it therefore seems hazardous to attempt the construction of it without the aid of practical information. Still, as we are informed, (in a way that cannot be doubted,) that Ducket's skim coulter plough performs the same useful depth of ploughing as is done by two ploughs in the usual way; also, at the same time, turns under and effectually covers long, strawy, farm yard manure, and the tallest green crops; it would seem that it should be introduced into this country, where labour is high and difficult to procure, and the grounds are but too seldom ploughed sufficiently deep: especially for maize, and some other fallow crops.

But to return. After the grounds have been prepared as above described, and the seed planted at a depth suitable to the economy of the plants, a level and superficial cultivation should follow, even when the soil is retentive of moisture. In case, however, of too much moisture for a level preparation of the lay, the sod should be properly ridged up at first. To prevent the middle of the ridge from being injuriously high, the two first furrows ought barely to meet each other in the centre of it. As ridges are calculated to produce artificial droughts, the least possible declivity is best: especially as the under drains formed by the furrow slices, together with the clearing out furrows, will be found sufficient to run off the superfluous moisture. After the ridges have been formed, the roller should be used to sink those parts of the furrow slices that, by lying hollow, are raised above the rest. When this has been done, the seams between the furrow slices ought to be well closed with the tined harrow. If the sod be very compact, (which generally happens in retentive lays,) a much better preparation for planting is obtained, by running the hoe harrow once or twice through the soil, before the tined harrow is used. The seams between the furrow slices will also be much better closed by this practice, as more loose earth will be obtained.

Care should be taken to keep the cleaning out furrows open during the cultivation of the crop. This may be done by the plough going up and down them, in the same tract, unless the excess of moisture render it necessary to preserve their original width. As the inequality in the surface will often prevent the moisture from running from one end to the other of the furrow slices, it should, in that case, meet with no obstacle that would prevent its escape at the sides of the ridges, into the cleaning out furrows.*

In the cultivation for the small grain that follows the fallow crop, care should be taken to order the course of the hoe and tined har-

* After very heavy rains, the plants standing in hollow parts of the field are sometimes very much injured, unless slight drains are formed by the hand hoe across the ridge where the water remains stagnant.

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rows, in that way best calculated to reduce the ridges as near to the form of flat beds, as can be done by the harrow going lengthwise of the furrows: as when I shall hereafter describe the proper cultivation for wheat sown in the fall, it will clearly appear, that if the cleaning out or water furrows are not wider apart than half a perch, this crop will not suffer, when sown on flat beds; even if the soil is not only retentive of moisture, but also spouty or springy to a considerable degree. It is evident, that the rotundity of ridges is very injurious, unless the spring and summer happen to be unusually dripping; and quite as obvious that the sun cannot act equally on every part of them.

I am well aware, that ridges of not half this width have been used and recommended by enlightened cultivators. It, however, should be recollected that these gentlemen pursued a cultivation calculated uselessly to waste the animal and vegetable matter contained in the soil. The latter, before it sinks deep into decay, has a tendency to keep the soil open, by separating its parts, even when it is only mixed through it; but this is far better effected by forming under drains with the furrow slices, well stored with vegetation.

If the grounds be not laid down in grass, to be continued for two or more years, after one crop of grain is sown on them, red clover should be sown with the small grain that followed the fallow crop. This should be mowed but once the ensuing year, and the second crop turned under wheat, sown in the fall. In forming the flat beds for this crop, in grounds which have been ridged up, the ploughing ought to commence at the former cleaning out furrows. In this case, the water furrows will be formed in the middle of the former ridges or beds. Care should, however, be taken to put the two first furrows very closely together, or the beds will be lowest in the middle, which would be very injurious to the crop. The water furrows for this crop should also be well regulated, and properly cleaned out. As the ploughing for every succeeding round of crops will commence at the water furrows formed for the last cultivated crop, every fallow crop after the first may be grown on beds perfectly flat, or with a little rotundity, if this should be considered best.

The under drains formed by the furrow slices will not continue open, *long* after the cultivated crop sown on the clover lay is removed. Neither should they, for the cleaning out furrows will be found sufficient to carry off the superfluous moisture from these grasses; as they require much more of it than cultivated crops. Hence it is that dripping climates are considered the best for grass, and that crops of small grain, when sown in the fall, do not generally succeed well in such climates, unless proper provision be made to run off the excess of moisture.

Here I wish the reader to observe, that the level cultivation means nothing more or less, than that, after the crops have been planted, all ridging, hilling, or moulding up should cease.

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Hilling, ridging, and moulding up plants, must have originated in barbarism, or but a few removes from it; like the practice of planting fruit trees as though they were fence posts. The latter practice, however, has been abandoned by enlightened cultivators, and the former will share the same fate, when nature and reason are harmonized in the practice of husbandry. Hilling, ridging, and moulding up plants have been the too general practice of the world from time immemorial. It is, however, as much opposed to reason and observation, as it is to the economy of nature, and these ought to govern all our agricultural pursuits.

When the grounds have been properly prepared for planting, no possible good can arise from this inconsiderate practice; except when applied to celery, or other plants, which habit has rendered more palatable when blanched. The evils arising from it, however, are many and great: it compels the plants to form new sets of roots, so often as they happen to be ridged or hilled up. This is done at the expense of those already formed, as the roots of plants cease to perform their proper functions when buried too deep within the soil: thus the efforts of nature are diverted by the folly of man, to useless and very injurious purposes, instead of being applied to the growth and maturity of the crop.

If the soil be too thin and weak, or the habits of the plants too delicate, to form repeated sets of roots readily, vegetation languishes still more, and the injury is greater. Hilling and ridging up plants, form furrows or gutters, exactly calculated to carry of the rains, and produce artificial droughts; yet so infatuating are long established practices, that the very obvious effects produced by them pass unregarded. Even sandy soils, which part with moisture too freely, under the best system of management that can be devised, are generally cultivated in this way. This very inconsiderate practice turns up the grass roots and dung, (if the latter has been applied,) and exposes them to the very injurious effects of the sun, wind, and rain: consequently scatters much of the nutriment in the air, which should be secured for the crops and improvement of the soil. Still we are told, that this is the proper way to "subdue the sod." This is not all, for the openings made by ridging up the plants, may be justly considered as main drains, communicating with innumerable avenues running in every direction through the ground, from which the moisture and confined air escape; and with them, the nutriment contained in the enriching matter buried in the soil. This checks fermentation and decomposition, and with them the exciting and nutritive principles arising therefrom. In fact, hilling and ridging up plants, may be justly considered, as in direct opposition to nature and reason, and of consequence to good husbandry. Still it has remained in general practice, except where the intervals between the plants have been so limited, that man, with all his ingenuity, could not devise means to effect the ruinous purpose, as in narrow drilled wheat, or turnips sown broad cast, &c.

The level cultivation which has been recommended should be

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only sufficiently deep to extirpate weeds. The less the open, mellow, artificial bed prepared for the growth of the plants is disturbed, the better it is calculated to promote vegetation: also, to secure the riches contained in it for the following crops and the improvement of the soil. The skim, with a proper rake attached to the hinder part of it, will effect this purpose in very narrow intervals, and the hoe harrow, with the tined harrow following it, in wider, with much less labour than the common plough, except where stones, and stumps with superficial roots abound. There the shovel plough, (with a share but little more pointed than one-half of a circle,) should be introduced, until a better tool has been invented for this purpose.

The common plough cuts off, laps over, and mangles the roots of the plants in ridging them up. Although the soil is not diminished by this inconsiderate practice, the roots of the plants are confined in heaped up ridges. This compels them to take such unnatural directions that their prosperity is greatly abridged; particularly in narrow intervals, and in these the injury is most observable.

When this instrument is used for ploughing from and to plants, the roots on the sides of them next to the intervals are cut off. The gentlemen who recommended this practice must have seen its injurious effects by the paler complexion and very slow growth of the plants, until they recovered from the very manifest injury done to them by this truly barbarous operation.

If they had recommended the tops to be cut off at the same time, uniformity would have been better preserved, with the additional advantage that might be derived from a new set of tops as well as roots. The subject is really too ludicrous to be treated seriously. Still, gentlemen of great talents have recommended this practice: however, nature, reason, and practice united, clearly determine that the less plants are injured in the cultivation, the better: provided the cultivation be equally good; and it may be far better. Repeated ploughing and harrowing pulverise the soil, and leave it quite open and mellow. It, however, too soon becomes compact, in consequence of the loss of the animal and vegetable matter exposed to useless waste by this injudicious practice, unless the soil be so rich as not to be materially affected by this very inconsiderate waste. Whereas, the fermentation of the animal and vegetable matter, when closely confined under the soil, will keep it continually open and mellow, for the ready admission of the roots of the plants.

We are told that cutting the roots increases the number of them, and that this multiplication of the roots greatly promotes the growth and prosperity of the plants. No question but that more branches will spring out from the stubs, after the roots have been cut off. It should, however, be recollected, that nature has formed the roots exactly to suit the economy of the plants, and that no possible good, but much evil, must arise from the ill judged attempts of man to improve the formation of them: especially by mutilating them ir-

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regularly, as is done by the plough. The injury done by this practice is readily seen by the procrastination of the growth of the plants, until these new sets of roots are formed.

I have carefully pruned, and too often ruggedly mutilated annual plants, by various injudicious systems of cultivation; but evil, instead of good, invariably followed, except when I removed the suckers growing near to the roots of their parent stem, and believe that even this operation should be very carefully performed, and while the suckers are very young.

Still, I do not question that the gentlemen who recommended ploughing from and to plants, grew good crops in that way. It should still, however, be remembered that talents, capital, and industry, have often done this, when a highly interesting part of the management has been excessively bad.

The usual mode of cultivation is not well calculated to subdue weeds. The seeds are as often turned down beyond the power of vegetation, as they are turned up. They are also buried underneath the heaped up ridges, and when the grounds are cultivated for the small grain, they are spread abroad. As this favours the vegetation of them, they often greatly injure the crops. These facts are best seen when the grounds have been manured for a fallow crop, with dung made by cattle fed on clover hay. In that case, the seeds buried under the ridges often produce as luxuriant crops of this grass as if they had been sown. This does not happen when a level cultivation has been properly executed. It turns up none of the seeds that are buried beyond the power of vegetation. They of course remain torpid, and as those near the surface vegetate, they are destroyed.

I have before observed, nothing but fire, or some cause that acts in the same powerful way, will destroy the vegetative powers of plants, as soon, or so effectually, as a well directed fermentation. Numerous instances of the powerful effects produced by this simple operation of nature, might be advanced. I have already mentioned some of them; but as it may lead the farmer to recollect others, and prevent the injury caused by them, I will briefly observe, that if a long spell of rainy weather takes place after grass has been mowed, and the swaths be not turned in due time, both the tops and the roots of the grasses covered by them are sadly injured, and sometimes effectually killed, by the fermentation occasioned by this covering alone. It also but too often happens, that both small grain and grass plants are greatly injured, or destroyed, by the still much lighter covering of the leaves blown on them from adjacent woods; when a boy or a girl with a rake, timely used, could have prevented the injury.

Now, if fermentation alone be capable of doing this, when but partially favoured, certainly vastly more is to be expected from this powerful agent, when its whole force is brought into full effect. No question but this is done when plants are turned upside down, and the vegetation arising from them regularly cut off a little within

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the surface of the soil by the hoe harrow, also overturned and effectually mangled by the tined harrow following it. The wounds inflicted on them, together with the close covering of earth above them, greatly promote fermentation, and of course hasten their destruction.

The reason why this powerful agent has not been brought into general use, seems to be simply this; farmers have not seen, when the tops and roots of the grasses, or other enriching manure are buried under the soil, and a proper cultivation pursued, that fermentation more effectually expands, divides, and keeps the grounds open and mellow than can be effected with the plough. We might, however, have long since seen the impropriety of the usual mode of cultivation, merely by walking through these parts of our woods which still remained well set with timber, and other native vegetation. There we might observe that our feet sunk freely into a soil, which nature had kept covered with leaves, and so effectually cultivated through the medium of this simple covering by fermentation alone, that the grounds were kept more open and mellow than our best cultivated fields: also, that the depth of this open texture was in due proportion to the animal and vegetable matter contained in the soil underneath the covering of leaves. We might likewise have seen that nature did not cut, rend, or mangle either the tops or the roots of the plants, and by this means debilitate, and procrastinate the growth of them, nor form hills or mounds around, nor furrows or ditches between them, to run off the moisture necessary to their growth.

There can be no difficulty in altering the present mode of cultivation, so as to save the farm yard manure, also, that arising from the roots of the grasses; and at the same time preserve the roots of the plants from injury by a level cultivation, when fallow crops are grown, or grass or clover lays alone. As peas and beans are frequently sown broad cast, and good crops of them are obtained in that way, they will certainly yield much larger crops, when kept free from weeds by a level cultivation.

Turnips, beets, carrots, and other taprooted plants grown for feeding domesticated animals, require a good soil, or the application of manure if the soil be thin: therefore, no grounds can be so well, and at the same time so readily prepared for the growth of these roots, as grass or clover lays properly trench ploughed, consequently there can be no difficulty so far as they may be concerned.

For turnips especially, the lay should be turned some time before the seed is sown, that sufficient fermentation may take place, to press the plants forward quickly into the rough leaf, that they may escape the fly. This will, however, be no disadvantage, as it will enable the cultivator to destroy the first growth of weeds, by the hoe and tined harrows, soon after they have germinated, and at the time to sow the seed for the crop. He should also recollect, that although the surface obtained by trench ploughing will be free from grass and weeds, and may be easily pulverised, so as to ap-

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pear as clean as a naked fallow which has been well prepared, still the seed of weeds will vegetate abundantly, and poison the crop, unless the plants be cultivated, and if they be sown broad cast, this must be done by the hand hoe.

Indian corn presents no difficulty to the practice recommended by me, for it is frequently grown on grass lays, from a conviction of their being the best preparation for this crop. Although the plants are in that case generally cultivated by ridging them up with the plough, there are some few who use the hoe harrow for the cultivation of maize, whether it be or be not grown on grass lays, because the use of this simple instrument saves much labour. There are also some few cultivators, who have extended their views still further; they have seen, that the level cultivation by the hoe harrow secured moisture for their crops, while those of their neighbours, who ridged up the plants, suffered by drought: also, that by this practice, the sod was more effectually decomposed. Some of these cultivators suffer the hoe harrow to dip too deep and injure the roots of the plants. Others separate the roots from them, by using, in a part of their cultivation, harrows with sharp cutting tines; and the whole of them, so far as I have seen or heard, turn up the lay with the plough, to prepare it for the small grain which follows the corn; still it clearly appears, that we have but little more to do, except stripping these various modes of management of their injurious absurdities, and uniting the remainder into a system consonant to nature and common sense.

It also clearly appears, that no difficulty can arise in growing potatoes on grass lays, for they are very often planted on them, and covered by the plough with the sod, and have been found sufficiently productive to perpetuate the practice; although the solidity of the sod previously to fermentation and decomposition, is sometimes such, that many of the vines grow under it in the form of a corkscrew, some time before they can either penetrate it, or find their way out between the furrow slices. This compels them to spend too much of their energy, and also time, before they get through the soil, which causes the plants which are thus circumstanced, to be very unproductive; this is not all, for they are generally buried too deep by ridging them up, not only with the soil in the intervals, but too often with the cold clay under it; the bulbs by this silly practice are oppressed with the useless and very injurious weight of the earth heaped over them. Ditches being also formed below the roots of the plants, they are sure to suffer greatly from this cause alone, except the season happen to be very wet.

Potatoes are also productive when planted on beds in the Irish way, and covered with the soil and inert earth found in the ditches between the beds; although they are generally planted on the hard sod, without any previous cultivation, and frequently without the application of manure; and the only cultivation bestowed on the plants is covering them soon after they appear, with the inert earth dug up from the bottom of the ditches. Yet Irishmen say this earth

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nourishes the crop greatly, when in fact it cannot possess the power of promoting vegetation in time to do the crop any good. The young weeds, however, are smothered by being covered over with it, and for this it happens by chance to be well applied. As it is not friendly to vegetation, but on the contrary, injurious to it, until it has been some time exposed to the atmosphere, it the more effectually destroys the weeds, and does not, (like hilling up with a nutritive soil,) excite the plants to form new sets of roots: consequently their energies are directed to the perfecting of their fruit. This is a level cultivation, but the ditches between the beds render it less perfectly so, than that arising from planting in every furrow, and covering the seed regularly as the ground is ploughed. When this is done, the crop is cultivated with the tined harrow alone; and though this savage practice mangles many of the plants sadly, the crops grown in that way have been sufficiently productive to induce a continuation of the practice. The largest crop that ever I have seen grown, (but one,) was obtained in this way without applying manure for it. It was grown on a stubble field, and the ground had been previously manured for the crop of rye. The soil appeared to be naturally thin, and did not seem to be better improved than might be expected from this irrational mode of cropping.

From the little that has been advanced on the cultivation of the potato, it appears that if the different usual modes of cultivating this plant be also stripped of their injurious absurdities, and that part which is consonant with nature and reason be retained, that a level system of cultivating it on grass or clover lays, may be very advantageously formed, as will more clearly appear when I describe the proper cultivation of that root.

It is not only in grass lays that a level cultivation is beneficial, for it is the best that can be pursued on grounds where the grasses have been generally obliterated by long cultivation, previously to preparing them for a fallow crop; provided enriching manure be applied. The manure is confined under the soil and the innumerable cracks which generally occur in grounds, where the animal and vegetable matter has been greatly exhausted, are filled up and closed, by the fine superficial tilth effected by the hoe and tined harrows. This excludes the injurious effects of the sun and air, and the fermentation of the manure is greatly promoted, which naturally expands, divides, and keeps the soil moist, open, and mellow for the ready admission of the roots of the plants through every part of it; especially if the manure be fresh and well stored with litter, and closely covered by the soil. Some gentlemen assert that such manure becomes a dryish wisp, incapable of affording nutriment for plants. Others that it injures vegetation by an excess of heat; the reverse of both these theories is true. When this kind of manure is applied in sufficient quantity to excite a profitable vegetation, (and neither less nor more, of any kind of manure should be applied,) the dried vegetable substances mixed with the dung, cause the fermentation and decomposition of the whole mass to progress gradually. The

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open texture of these dried substances naturally imbibes a large quantity of moisture. When lack of rain, drying winds, or the heat of the sun causes the soil above them to dry, they naturally part gradually with a greater abundance of moisture confined in them, to supply the deficiency above. When these substances become less moist than the ground underneath them, they act like a sponge and absorb the moisture from below; this they continue to communicate to the soil above. While this interesting process is going on, they shield the ground underneath them from the too powerful effects of the sun, which checks evaporation of moisture from it. The substances contained in the long manure are powerful nonconductors of heat. This is clearly seen when a slight hoar frost occurs. None of it is to be found on the ground; while the dung, dropped by the cattle, is covered with it. As the dung has not been decomposed, the woody fibre which forms a considerable proportion of it, prevents the heat arising from the earth, from melting the frost on the surface of it. In fact, a single straw lying on the ground, is sufficient to prevent the heat given out by the earth (when the air above is cooler than it,) from melting the hoar frost on the upper side of the straw. Now if gentlemen, before they wrote for the express purpose of teaching us, would carefully study the effects produced by the simple and very obvious operations of nature, these errors respecting fresh manure, and many more equally absurd, would cease to exist.

Those who wish to test this fact, have only to use strawy fresh muck for a part of a fallow crop, and decomposed dung for another part of it, and observe the effects produced by both. If the soil be the same, it matters not whether the experiment be tried on stiff retentive clay or sand; in either case the soil will be moister, during a dry time, where the strawy fresh muck had been used: if the cultivation be calculated to keep the manure closely covered within the ground.

Although I have pointed out the best course of cropping that has been practised, I have no idea that this course can be pursued, except where labour is plenty, and the farmer employs a capital equal to the task; neither do I believe when the cultivator is possessed of these means, that he should be tied down to any course of crops, nor to any particular plants. It is the principles of cultivation and management only, that I mean to establish: I therefore wish the farmer clearly to understand, that, if his capital be sufficient, and labour can be had, and his soil has been properly enriched, his course of crops, also the plants cultivated by him, may be such as best suits his purpose; provided a sufficiency of grass crops be grown between the cultivated crops; and his cultivation and management be calculated to save the animal and vegetable matter from useless waste. It has been too long expected that agriculture was to be highly improved by certain rounds of crops, and these have been very ingeniously diversified, and multiplied, so as uselessly to waste much paper, ink, &c. under this mistaken idea. It

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is, however, evident, while the soil continues thin, and even when it is good, that if the farmer either cannot, or will not, employ a sufficient capital to keep an extensive stock of cattle, &c. he must practice a lenient course of cropping, and introduce lenient plants much more frequently than would be necessary, if he could command a good stock of manure; otherwise his grounds, in place of being made better, will eventually become poor. It also clearly appears, if nature and practical observation be consulted, that whether the grounds be rich or poor, or enriching manure be plenty or scarce, a rational change of the vegetation grown on the same soil should invariably take place.

It will too frequently happen, especially when the cultivator follows a bad farmer, that much of the soil will be found too thin to grow a fallow crop, and also a crop of small grain to be followed by grass, when enriching manure cannot be applied. In this case it is highly important, that the grounds be prepared for the small grain in that way, which will cost him much less labour, and produce a far better crop, than a naked fallow cultivated in the usual way. Also save the animal and vegetable matter from useless waste, and apply the nutriment arising from these substances to the growth of the crops, and enriching the soil.

The stubble, grasses, or weeds, (as the case may happen to be,) should, if fall grain is sown, be well turned under the soil, the furrow slices levelled with the roller, and the seams between them well closed with the tined harrow, going lengthwise of the furrows. The time of ploughing ought to be so ordered, that two several distinct growths of the weeds which vegetate, may be destroyed by two very superficial cultivations, done at distinct, and distant periods, by the hoe harrow, with the tined harrow following it; and so managed as to give time for a third growth of weeds to take place, previously to the seed being sown. On this third and last growth of weeds, the small grain should be sown, before the superficial cultivation of the hoe and tined harrow; this will answer the double purpose of putting in the seed, and destroying the weeds, provided care be taken, that the size of the weeds be not so great as to frustrate the design.*

If spring grain is to be sown, the cultivator should calculate to turn the stubbles, grasses, or weeds under the soil at a later date, so that the weeds grown after the second cultivation done in the fall may not be found, in the spring, large enough to prevent the effectual destruction of them, by the hoe and tined harrow, in the way which has been described above.

Here it may be proper to remark, that as grain sown on a thin soil in the fall is often greatly injured, and sometimes ruined by the frost of the ensuing winter and spring, I would advise the cultivator (if bread corn be his object) to sow either spring wheat or spring rye.

* One of those cultivations may be safely omitted, if the grounds be not, (as too often happens,) overrun with brambles or hardy weeds.

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As frost locks up vegetation in some situations much sooner than in others, I am compelled to leave the time when the stubbles, grasses, or weeds should be turned under the soil, to be determined by the practice and observation of the cultivator.

It is also worthy of remark, that if the grounds should be too thin to grow profitable crops of small grain, such green crops as they are best calculated to grow, ought to be previously cultivated and ploughed under for manure; after this has been done, the grounds should be cultivated as above described, previous to sowing the small grain. It is a very mistaken economy, to save in labour, a much less sum than will be lost, by having the crop of small grain, and the grasses following it, choked and poisoned with weeds: especially as the hoe and tined harrows properly constructed and ordered, will perform the labour with great despatch. As none of the seeds of the weeds buried beyond the power of vegetation will be turned up by these implements; and those that are near the surface will not be turned under, much fewer weeds will appear in the crops, than would follow the very laborious and expensive process of a naked fallow well executed in the usual way. It should also be well remembered, that the animal and vegetable matter contained in the soil, is saved from useless waste by this practice.

Fallow crops require much more labour than can be readily procured in this country, to grow them to any thing like that extent, which would be sufficient to prepare the soil for the wheat, rye, and other small grains that are sown: consequently, much wheat, and other small grain is grown on grounds which have been prepared by a naked fallow; these are seldom ploughed more than three times, and I have seen luxuriant wheat grown on grounds which were good, and also well stored with the roots of the grasses, when they have been but twice ploughed: however, when the seeds of weeds abound, this seems to be a risking practice.

As clover lays are not generally cultivated until the greater part of the plants has been destroyed in the way that has been described, and hardy grasses and weeds have taken possession of the space occupied by them, and the soil is consolidated by time and the hoofs of the cattle, or as farmers commonly term it, becomes hide bound; it has been found that wheat, or small grain, does not commonly prosper on them when sowed on one ploughing, or on speargrass lays, when they are matted and bound. To remedy this evil, the grounds are often sowed with buckwheat on one ploughing, but more frequently after it has been twice ploughed, and the grounds are cultivated the ensuing year by a naked fallow, and sowed with wheat, of which good crops are often obtained. The product, however, obtained by either of these practices, is frequently scanty, and seldom, if ever, as luxuriant as it would be if a better system of management were pursued. Added to this, one year's rent of the soil is commonly lost in preparing the naked fallow for wheat. The animal and vegetable matter contained in the land is also exposed to much useless waste; and as three or four crops are

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commonly grown before grass seeds are sowed, (of which the farmer seldom sows half enough,) the soil is eventually impoverished, unless these evils be counteracted by keeping an extensive stock of cattle, and using much enriching manure. On the contrary, it too commonly happens that, in place of using enriching manure, the injudicious use of lime and gypsum hastens the destruction of the soil. There are, however, many plain, practical farmers in this country, who do keep extensive stocks of cattle; make much manure, and, notwithstanding I believe they might generally use it more advantageously, and greatly improve the system of farming, it is evident that their present mode of management does honour to their profession.

Of the management of those who sow no grass, except a patch of bottom meadow, barely sufficient, with the aid of much straw, to keep their scanty stock of cattle from perishing with hunger through the winter, nothing good can, or ought to be said, so far as farming may be concerned. These perpetual ploughers and croppers seldom suffer the grounds to lie sufficiently long to be well covered by the slow but certain hand of nature, even with weeds. Their crops, of course, are commonly very scanty. This seems to induce them to perpetuate the practice; for if much ground be not cultivated, a product sufficient to answer their purpose cannot be obtained, unless a better system of management were pursued.

Now it may be truly said of these men, that "they" seem to "love to grope in the dark," and that, so far as agriculture is concerned, they act as would do "the most ignorant set of people in the world." If, however, proper measures were taken to convince them that their system of management was very injurious to them, it would, in process of time, be found that they are not so ignorant as some seem to imagine. Since I removed to the back-woods, where such farmers are more especially plenty, I have had a better opportunity of observing their talents, and must confess that I have found them much more respectable than I formerly believed them to be.

They will quickly build an ark, of very considerable burden, without a particle of iron, or an inch of cordage; and in the time of a freshet, when the waters are pouring down our rivers and creeks with astonishing velocity, they will, with great dexterity and intrepidity, conduct this vessel, heavily laden, between rocks and through waterfalls. They will patiently encounter a long and fatiguing journey back on foot, heavily laden with necessaries for the use of their families. Thus they become travellers; and as rubbing through the world generally sharpens a man's wit, they return home much better informed, having seen and heard much by the way: likewise, become well versed in barter, purchase, and sale.

These men, with no other tools than a common axe, auger and pocket knife, will, with astonishing expedition, build a tight and comfortable dwelling house, or a convenient barn, without a single

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nail or a particle of iron. The floors strong and well formed; the doors conveniently hung; and decent sashes for the windows, first roughed out with the axe, and then finished with the pocket knife. Such household furniture as answers their purposes is also made with the same tools. So are their implements of husbandry, except the iron work, which is also made by some of them, and there are but few who cannot make the shoes worn by their family. The dexterous use of the rifle furnishes most of the meat that is eaten by them. They dress the skins of the deer, and often, without either needle, silk, or thread, make well looking pantaloons of them; and when money is scarce, some other parts of their dress are also formed of them. They will scald and clean a hog without either pot, kettle, or any other fire proof utensil.

In fact, these men generally come into the back-woods exceedingly poor. They seldom have more money than will pay their expenses on the road, and often do not bring more than a horse and cow with them: therefore, are commonly much better stocked with young, helpless children than they are with cattle: consequently, they are compelled to exercise those talents which nature distributes without partiality, or starve.

Now, it is evident that there are no cultivators of the soil in Pennsylvania, that farm worse than do these men. Also, that they possess sufficient talents to farm quite as well as any other "set of people in the world," who possess no more capital than they do, if these talents were properly directed. It is likewise evident that they understand, and have sufficient ability of body and energy of mind to perform all the different branches of the manual labour done on a farm; and that very cramped circumstances have taught them to exercise their ingenuity in every possible way to save labour and expense; also, to live on homely fare. Therefore they ought to be instructed; but not to engage in doubtful, or uselessly expensive practices. These, it must be confessed, have (together with other practices that are really good,) been too often indiscriminately and highly recommended to every class of farmers: although common sense and observation clearly dictate that the farmer, who is either cramped in his circumstances, or possesses more cleared land than he has sufficient capital to cultivate, in the most advantageous way, or cannot procure enough of labour to effect this purpose, neither can nor ought to attempt to farm, as those should do who possess the means by which they may readily effect this invaluable end.

The true state of the case is simply this; there is much more cleared land in the United States than there is labour or capital to cultivate to the best advantage, and this state of things will exist while large bodies of back lands remain to be sold at very reduced prices. The question, therefore, is not only how the soil may be so cultivated that it will produce the most neat clear profit, with the least possible labour and expense, but also, how are the different grades of farmers, (from those who have it in their power to

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farm in the best way, down to the indigent cultivator in the backwoods,) to manage so as to improve, in place of impoverishing, the soil; and at the same time obtain as much neat clear profit from their grounds, as can be rationally expected from the capital employed, and the labour that may be readily procured?

It has, and will be, my aim to explain these important questions How far I may succeed will be best determined by the reader after he has perused my advice to gentlemen farmers, and also to he cramped or circumscribed cultivators of the soil.

But to return to the practice of those who prepare the soil for a crop of wheat, or other small grain, by a naked fallow, although it is sufficiently rich to be prepared for these crops by the cultivation of a fallow crop, were it not that either a deficiency of capital or scarcity of labour intervened.

It would be a far better practice to turn up and prepare the grass lay in the way that has been recommended, (when the grounds are not too thin to grow more than one crop of small grain,) either for wheat or other small grain; and after the crop has been removed to cultivate the stubble grounds superficially with the hoe and tined harrow alone, (as often and in the same way as has been recommended,) for another crop of small grain, but of a different kind. On this crop, grass seed should be sown, and the ground ought to be continued three years in grass, unless the soil be rich and deep, or enriching manure has been applied.* In the latter case, the lay may be turned up in two years, for another course of crops. Good crops of rye and oats have been obtained after wheat. But if the soil be rich and deep, or has been well manured, barley will be more profitable, where it is in demand. Stubbles should always be cut low; especially to be cultivated by the hoe and tined harrows. If cut high, they are dragged up into heaps, and injure the crop.

A still more lenient and profitable course of cropping would be to sow clover on the first crop of small grain. Mow the first crop of that grass as early as it ought to be done to make good hay, and turn down the second crop for wheat; level the furrow slices, and close the seams between them in the way that has been directed. This should be done in time for a crop of weeds to vegetate. On this crop of weeds, (which should be young and small,) sow the wheat, and put it in with the hoe and tined harrows. On the wheat sow grass, to be continued two years. Ploughing a clover lay more than once, is a very bad practice; but the destruction of the weeds by a very superficial cultivation will pay the farmer well, both in the wheat and grass crops following it.

A still more profitable course would be, to turn up the grass lay, level the furrow slices, and close the seams between them. On the young growth of weeds, described above, sow buckwheat, Albany, or lady peas, broad cast. Put them in with the hoe and tined har-

* If enriching manure be applied, it should be spread over the sod, and turned under with it.

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rows, as before directed. If peas be sown they will come off in time to cultivate the grounds with the hoe and tined harrows for fall wheat, to be sown on the young crop of weeds, which should be suffered to vegetate before the small grain be sown. On this young growth of weeds sow the wheat, cover it with the hoe and tined harrows, and the same cultivation will destroy the weeds. Sow clover on the wheat, mow the first crop of that grass, and turn under the second crop for another crop of wheat; for which, cultivate the clover lay, put in the seed, and destroy the young growth of weeds, (which should be suffered to vegetate previously to sowing the seed,) in the way mentioned before. Sow speargrass on the wheat, to be continued three years. If dung be applied for the peas, the speargrass lay may be cultivated in two years.

Buckwheat, if sown at the usual time, will come off later than the peas: consequently, it will be best to cultivate the ground after the buckwheat has been removed with the hoe and tined harrows, so that the weeds which vegetate in the fall, (after this cultivation,) may not be found too large to be effectually destroyed by the cultivation with the hoe and tined harrows that covers the seed of the small grain. This should be sown on the growth of weeds so soon in the spring as the frost will permit it to be covered. Sow clover seed on this crop. Mow the first crop of the clover, and turn the second crop under for wheat. Cultivate the clover lay; also, sow and put in the seed, and destroy the young growth of weeds, (which should be suffered to vegetate after the cultivation,) in the way that has been directed: sow speargrass on the wheat, to be continued three years, or but two years, if dung was applied for the buckwheat. It may be best for a crop of spring small grain to follow the peas; but as they will come off early, the growth of the weeds may be such as to require two cultivations to be done in the fall by the hoe and tined harrows, or the weeds may be found too large in the spring. As clover will be grown between the crops of wheat, and speargrasses will have occupied the grounds two or three years previously to the first crop of wheat being sown, it is believed that no injury will arise from sowing wheat twice, in so short a time, on the same grounds. However, if any should appear, a suitable crop of small spring grain may be introduced, instead of one of the wheat crops. It should be observed that soils differ so very widely, that it may be found, (where dung is scarce,) necessary to turn the tops of the grasses under the soil more frequently than has been recommended above. Of this, however, the cultivator who will see the result of his cropping, will be the best judge. But certain I am, that no soil should be cultivated in that way which will make it poorer: also, that it will be to the interest of the cultivator who has not a sufficiency of farm yard manure, to apply the tops, as well as the roots, of grasses, to this purpose, as often, and in such quantities, as will insure the gradual improvement of his lands. He will not only improve the soil by this practice, but also make much more money than by following an opposite mode of management.

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Here again it may be proper to remind the reader, that this course of cropping is merely introduced, to show, how the soil may be preserved from that wide waste of ruin which is too often seen: also made better by a judicious growth of the grasses between the cultivated crops; provided they be properly applied, and the nutriment introduced by them, be saved from useless waste. Likewise to convince him that in doing this, much useless and very injurious labour will be saved, and the product of the soil greatly increased. It is, however, by no means necessary to adopt any of those courses of crops. Still, if he be either cramped or circumscribed in his practice, he may rest assured, that his interest and future prosperity are closely connected with putting the lenient principles on which those rounds of crops have been generally predicated into actual practice. But he should do it in that way which will best suit his purpose, or the peculiar situation in which he may happen to be placed.

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CHAPTER XVI.

Observations on what some say of the earthy texture of the soils, and the manures to be applied to them. Also, on the different circumstances, capital, and situation of farmers. A concise description of the best course of crops. Remarks on the width of ridges in retentive soils. A description of the cultivation of a crop of wheat grown on a springy soil, with observations on the result. Under draining soils which are merely retentive of moisture, is a useless, injurious, and very expensive practice. Proper water furrowing for small grain explained; also, observations on the ruinous and too general neglect of this practice.

Having explained the general principles of a proper cultivation of the soil, it becomes necessary to show how they should be applied to a round of crops. But it would be an endless as well as a useless piece of business to attempt to diversify them to suit the soil, capital, and situation of farmers in general. I have never seen cause for the voluminous and perplexing distinctions that too many attempt to make, between the capacity of soils of different textures, either as it respects the manure which should be applied to them, or the growth of any of the plants generally cultivated by us. On the contrary, some of those soils which are commonly represented as unfit for certain plants, will produce larger and better crops of them than the soils which we are told favour their growth, provided they be properly cultivated. Enriching manure certainly acts powerfully on every soil if enough of it be applied, or in proportion as it happens to be more or less nutritive. The principal use of stimulating manures, is to decompose more hastily the animal and vegetable matter found in the soil, and excite vegetation.

There can be, however, no question but plants have their favourite soils; when gratifying them does not break in upon that system of management best suited to the purpose of the cultivator, he will find it much to his interest to favour this propensity; especially when he lays down his fields in grass.

Then if practicable, he should sow only such seeds as are adapted to the soil. As those are best calculated to yield the largest or most profitable crops, they will most effectually fit and prepare the lay, (by filling it with vegetation,) for the cultivated crops which may be best calculated to promote his interest. Here it may be proper to remark, that the increased vegetation will far better effect this valuable end, than the expensive labour of hauling and mixing clay with sand, or the sand with clay.

This may be easily seen when gardens are formed on grass lays, which frequently happens near to our cities or large towns, where the old fashioned buildings on farms are but too often sacrificed for

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such as are better liked, and also placed in more eligible situations. On this little spot an immense variety of plants is immediately introduced, and each grows luxuriantly. The gardener first spreads the manure on the lay, and turns it with the sod under the soil so deep, that the grasses do not prove troublesome to him: for although he adopts the savage practice of hilling up the plants, this operation seldom extends so deep as to turn up the sod.

Gentlemen who live in the country might have everlasting gardens, which would never become either (what is termed) sick of particular plants, or of manure. To do this, ground enough should be allotted, to admit a regular succession of the grasses to be grown between the cultivated crops.

It would add greatly to the beauty of a garden, if a variety of handsome grasses were selected for this purpose, and no question but a level cultivation would look much better than hills and hollows. The scuffle (or D hoe as it is sometimes called,) will destroy weeds growing on a level surface, with very great expedition.

Even celery which cannot be cultivated level, would be greatly benefited by reversing the sod removed from the surface, and placing it in the trench underneath the roots of the plants. No ground would be lost by increasing the size of the garden, as the grasses might be mowed and fed green to the cattle, or made into hay.

But to return. Some farmers occupy poor soils, others rich, and many the different grades between these wide extremes. There is quite as much difference between the extent of capital possessed or used by many of them. The difference of population and practicability of procuring labour in our extensive country is also very great. The markets and the expense as well as the means of transporting different crops to market differ widely. This extensive diversity does not, however, create any difficulty, so far as good farming is concerned. The cultivator (whether he be rich or poor,) who occupies no more soil than is consistent with his capital and means to cultivate it, may grow any cultivated crops that best suit his purpose, provided a sufficiency of grass crops intervene, and the whole be properly ordered.

It should, however, be recollected, that this cannot be done until the grounds have been covered with grass, and a sufficient stock of cattle introduced. Also, that when the farmer occupies more soil than his capital is capable of cultivating to the greatest advantage, he must for a time adopt a more lenient course of cropping. This will be fully explained in my advice to the circumscribed farmer.

The best course of crops, where the produce may happen to suit, and when the round is carried to a considerable extent, is: First, a manured fallow crop grown on a speargrass lay. Secondly, a crop of winter or spring small grain. Thirdly, red clover to be mowed but once. Fourthly, wheat grown on the clover lay, after the second crop of that grass has been turned under for manure. Fifthly, speargrasses, to be continued two years.

I have commonly practised a shorter round of crops, to wit. First,

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a fallow crop grown on a speargrass lay, properly manured. Secondly, wheat or barley. Thirdly, speargrasses mowed three years. If I had continued on the farm near Philadelphia, until it had been properly enriched, the speargrasses would have been turned up for a fallow crop after they had been only two years mowed.

Either of those systems of management is excellent, when capital and population will admit them to be employed. The latter introduces fewer weeds among the wheat, and less slabbering among the cattle. However, if the cultivator will turn the red clover lay soon enough to admit the cultivation by the hoe and tined harrows (which has been described,) his crops will be equally free from weeds; and no question but they will be more productive than those put in by the tined harrow alone.

It, however, should be observed, that unless the clover lay can be water furrowed, so that the parallel furrows will carry off the superfluous moisture, the furrows formed across the lands, to effect this purpose, will furnish a quantity of vegetation, which, unless it be minutely separated and very thinly strewed over the lands, will greatly injure the crop on which it lies. Also, that where obstacles obtain, the lay cannot be well turned, and this difficulty will be greatly increased, if the grounds lie so as to require much water furrowing across the lands.

If the grounds be retentive of moisture, and maize is planted for the fallow crop, they should be formed into ridges of three-quarters of a perch or eleven feet from centre to centre of the water furrows, in the way that has been described. Two rows of corn may be planted, five and a half feet asunder on each ridge, in the way that will be explained. This will place the middle of the ridge where the dung and soil has been doubled by the ploughing immediately between the two rows of maize. However, the lateral roots will soon find their way into it, and the top of the ridge will be more readily flattened by cultivation for the small grain and grasses; for which ridges of five and a half feet would be too narrow.

For potatoes, beans, and other low growing plants, the ridges should be of the same width as for the corn; on these the cultivator may form the rows at that distance apart which best suits the economy of the plants.

Care should be taken in forming the ridges to pare off the last furrow slices which form the outside of them as narrow as it may be well done, for this will contract the width of the water furrows.

As ridges are by no means equal to beds that are flat, or nearly so, either for the growth of fallow crops, or the small grain and grasses following them, they would not be introduced by me, if it were practicable to form proper water furrows without doubling the soil in the middle of each ridge; they may be however considerably flattened in the cultivation of the fallow crop, also by the hoe and tined harrows, when they are cultivated for the small grain.

There is reason to believe, that crops may be advantageously grown, even on soils where spouts and springs abound so much,

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that the greater part of the fallow crops planted on them would dwindle and perish, and the crops of small grain grown on them, (especially if sown in the fall,) would be scarcely worth gathering, if cultivated in the usual way.

However, of this the reader may form nearly as correct an opinion as myself, from the facts which I will now relate.

In the fall of 1814, I determined to sow wheat upon about two acres of ground, from which two crops of potatoes had been previously taken; the last of consequence nothing like as productive as the first.

As the soil was fresh and middling good, no manure was used either for the potatoes or wheat; there were some springy places in an adjoining field lying on the higher grounds above; as soon as the water from them entered into the grounds where the potatoes were grown, it sunk out of sight, through a loose soil which lay on a gentle declivity along the upper side of the patch; as the water after this met a stratum of clay lying near to the surface, it rose and appeared again on the top of the ground in the middle of the patch, spreading itself nearly from one end to the other.

The ground being flat in the middle of the field, it afforded no vent for the water until it had progressed near to the furthest side of the patch; as the ground there was higher, and its texture loose and open, the water again disappeared.

Still a sufficiency remained, spread over the flat retentive clay soil to keep it so wet, that many of the potato sets rotted; and turnip seed sown after this happened, did not vegetate, except in chance spots which lay something higher than the rest of the ground.

I had determined after the wheat was sown, to cut off the springs by forming a ditch along the upper side of the field; but finding the open texture of the ground run very deep, the project was abandoned.

It, however, fortunately happened, that the field had been well water furrowed. That proper water furrowing, and its important effects, especially in moist, cold, and unfavourable climates, may be better understood, than it seems to be, I will describe the cultivation of this little patch of wheat.

The grounds were staked off at the head and foot of the patch to regulate forming the lands; these were half a perch, or eight feet three inches wide, from centre to centre of the water furrows.

The wheat was sown at the rate of two bushels to the acre, without any previous preparation, except that made by the removal of the potato crop; it was covered by the shovel plough; and by passing twice in each water furrow, they were formed as well as it could be done by that instrument; many stumps, with large superficial roots, prevented the introduction of the long plough, or the furrows might have been much better formed by it.

After a few lands were laid off by the shovel plough, the labourers who followed to regulate the furrows, were each of them fur-

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nished with an axe to cut roots a mattock to remove the hard earth and stones, and a shovel to clean out the furrows. The earth removed from them was thinly scattered over the lands, taking care to cover with the richer part of it, the seed lying in the forks formed by the roots from the stumps, as this could not be well covered by the shovel plough.

Each proceeded in his own furrow, until a stump or large root opposed his progress. In either case he formed a cut across the land to empty the water into the water furrow, on that side of him which appeared best calculated to run it off. When this was done, he returned and commenced again in the furrow he had left, at the lower side of the large stump or root which had opposed his progress.

They proceeded in this way, still cutting the smaller roots which lay in the way of forming the furrows, and leaving the larger ones uncut; also, removing and regulating such heights in the bottom of the furrows, as would prevent the water from running off freely.

The hollows and lower parts of the field were well drained, by forming a few deep furrows in such directions through it as seemed best calculated to run off the water from the regular parallel furrows which emptied into them.

The water furrows were in general formed not more than six inches deep. A little depth below the ploughed ground seemed to be sufficient to run off the water from the lands, as it would naturally filter through the cultivated grounds, and find its way into the furrows, either from the sides or ends of the lands.

For as the soil had neither been exhausted nor ploughed deep, it still remained free and open, in consequence of its earthy ingredients being intimately blended with a variety of vegetable matters, which had not yet sunk into decay. After the patch was water furrowed, it was considered necessary to cut off the water from the rain and snows which would fall on the land above it. This was done by forming a furrow on the upper side of the field, sufficiently deep and wide to arrest and carry off the water. The same was also done at one end of the patch, where the grounds lay higher than it. No stagnant water appeared after this on the ground: still the water from the spouts never ceased to run in some of the furrows, from the time the wheat was sown until it was cut, except during hard frost or a dry time; but more abundantly when the earth was generally well stored with moisture. The plants, however, maintained their vigour in the spouty places, as well as where the soil was drier, although most of them were cut off by the deer, level with the ground, through the winter and early part of the spring.

When the wheat was ripe, it appeared that the plants standing where the water sunk out of sight, as soon as it entered the field, were so luxuriant that a great part of them fell. This I attributed to the effect of moisture at a favourable depth under their roots.

The success of this experiment induced me, the ensuing fall, to sow wheat on about two acres of ground, which lay adjoining the

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wet grounds which had been successfully employed in the same way. On those two acres there were four small swampy places, which were so wet that the horses sometimes sunk up to their knees in ploughing through them. While the labourers were cleaning out the water furrows which ran through those boggy places, they were obliged to stand in them. If they set their feet on the lands, they sunk into the miry soil. However, as the furrows were made from nine to ten inches deep, the moisture escaped into them, and ran off in the course of three or four days, so that we could readily walk over the lands without sinking into them. The wheat did not vegetate or come up so thick on the boggy places as on the rest of the field. The fall and fore part of the winter was unfavourable for winter grain. The frost was severe, and but little snow until after Christmas. During that time the wheat was frequently seen, and the boggy places did not appear to be injured by the weather more than the rest of the patch. After this, the plants dwindled on those swampy spots, and at harvest no grain was reaped from off the wetter parts of them. What might have happened if those parts of the furrows injured by frost, &c. had been kept properly open is unknown to me.

However, this last experiment seems to determine that if spouts run so deep that the water furrows cannot be readily carried deep enough into the solid ground underneath them, such grounds should be kept in herdgrass, and not otherwise cultivated until they have been properly drained.

The first experiment seems as clearly to show, that when the water furrows may be readily formed deep enough into the solid ground lying under the spouty soil, that such grounds may be advantageously employed in growing wheat, and perhaps other winter grain.

This, with various other facts, appear to determine that immense sums of money have been uselessly expended, (especially in England,) in under draining soils which were merely retentive of that moisture which either fell or ran in upon them. It may be as clearly seen as almost any other thing, that moisture arising from these causes can be much more effectually run off by properly water furrowing the grounds when they are cultivated, than by under draining.

The water arising from rain or snow falling or running on a retentive soil, runs very quickly off narrow lands, properly constructed, into the water furrows. Much less of it, consequently, sinks into the soil, than when a level surface is preserved by under draining. If the water furrows be well constructed, it is as quickly conducted off from the field by them.

When grounds are under drained, the moisture has to find its way through the soil into them. This must be a tedious process; it being evident that water filters very slowly through retentive grounds, more especially in a horizontal direction. A few inches

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thickness of retentive clay has been found sufficient to prevent any very material escape of water from the cisterns lined with it.

Practice has long since determined, that such under drains as are commonly made to drain retentive soils, are by no means well calculated to run off the water after it has found its way into them. They are very frequently stopped up by the earth falling into and filling the cavities between the various materials laid in them. The roots of some plants grow so luxuriantly in them that they stop up the passage through which the water ought to pass. The fashion of the day, however, will be followed by too many, be the consequence what it may.

It has been urged, that when grounds are under drained, they may be covered with more plants. It should, however, be recollected, that there are but few fields from which the soil and plants will not be ruinously washed away, unless a sufficiency of open furrows be formed to carry off the water arising from rain and melting snows. It is also worthy of remark, that plants require air. Therefore, it does not appear that the product will be less in consequence of a part of the grounds being occupied by open furrows, if the plants be judiciously arranged on the soil.

There is, however, seldom any general rule without exceptions. Springy places in a field are sometimes so situated that they cannot be conveyed from it by open drains, so that the cultivation of the grounds will be tolerably convenient.

In this case, where the price of land is high, and the cultivator's capital will admit the enterprise, under drains should be formed. They should, however, be far better constructed than those commonly employed in retentive soils. The formation and materials used in constructing them ought to be well calculated to prevent, (as far as it may be readily done,) the evils enumerated above.

Now, if this reasoning be correct, and it does not seem that it can be rationally controverted, great sums of money have been spent in under draining, which, in place of doing good, has effected serious injury.

But nature, reason, and observation, (which should be the farmer's guides,) are too seldom consulted in agricultural pursuits. If British agriculturists had been governed by them, they would not have suddenly leveled the ridges which their predecessors had inconsiderately raised. This made a great proportion of the ground barren for a considerable time; also, rendered it incapable of promoting vegetation without the application of much enriching matter.* The manure uselessly wasted in enriching that part of the

* For the truth of this, see what is said in the third volume of the Memoirs of the Philadelphia Agricultural Society, page 161, by Mr. Lang, who advocates this laborious enterprise, and also borrowing money from banks to effect it, notwithstanding he clearly points out the injury done to the soil; also, tells us the men who did it were renters, (not owners,) of the ground. He, however, intimates that they became wealthy; still, as he says, several banks were originated to aid their enterprise. This appearance of wealth may have been

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ground which had been entirely stripped of all its vegetable mould, would have made an extensive improvement if it had been judiciously employed. A well directed cultivation would have gradually leveled the ridges quite as effectually as it was done by the expensive labour employed, and without burying the vegetable mould where it could do but little if any good, or turning up the barren and inert earth suddenly. But farmers, like the rest of the world, after they have acquired more money than good management, (even if it be from banks, on loan,) too often make either real or imaginary improvements, with inconsiderate and very expensive rapidity. A handsome, well formed field, house, or barn, is a pleasing, interesting object: if either, or the whole, happen to be the prevailing fashion of the times, they are but too frequently followed with great avidity, without duly considering the merit or demerit of them.

But to return to the first cultivated patch of wheat. It would appear from the result of this experiment that if the soil be tolerably well stored with vegetable matter, which has not sunk too far into decay, and it be also well water furrowed, wheat will prosper, if the grounds be, to a certain extent, spouty, when sown on beds that are perfectly flat, and half a perch or eight feet, three inches wide.

This seems to determine that grass lays which are merely retentive of moisture, may be safely formed into lands of three-quarters of a perch, or eleven feet wide, from centre to centre of the water furrows. In this case each furrow slice forms an under drain, which remains more or less open until the cultivated crops be removed. The open furrows alone will be sufficient to run off the superfluous moisture from the grasses; particularly, as more of it is necessary to the luxuriant growth of them, than to that of most cultivated crops.

It is difficult, (and perhaps not possible,) to point out the proper width of lands, for soils of different textures, and in different climates. I believe, however, that there are but few, if any, soils in high latitudes, that should be water furrowed wider, for winter grain, than one perch, or sixteen feet and a half; and that in lower latitudes this width will be generally better than a greater distance, unless the soil be very free and open.

But the cultivator should remember, that whether the lands be narrow or wide, if there be hollows in them, the water will lodge in them. Therefore, slight drains should be formed to run it off into the furrows. If this be not done, the plants growing in those hollows will perish, unless the open texture of the soil may happen to filter off the moisture before it is arrested by frost.

The furrows for spring grain may be formed wider apart than those for winter grain: still, it is best not to make them very wide asunder, as the grounds may wash, and when the lands are wide, it is much more difficult to form cuts to run off the water, (that

fallacious; but, be this as it may, certain I am that leveling the ridges, as it was done by them, was far better calculated to ruin than enrich them.

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may lodge in the hollow places,) into the water furrows. When this is not done, the plants are often killed, or turn sallow, and become sickly and feeble by this excess of moisture.

The mode of forming and regulating the furrows has been explained; also, how they are to be managed when obstacles obtain, or low places occur in the field; and the cultivator should never forget to exclude the waters from any grounds that may happen to lie higher than it. This cannot be always done without conducting a part or the whole of the water through the field. To prevent the grounds from being washed into gullies, or other mischief done, he should cause it to pass through as many of the different furrows as may be conveniently done, taking care to make them sufficiently wide and deep to carry off the water readily.

Great injury frequently arises from not arresting and properly conducting the water from without. It greatly adds to the moisture within the field, and sadly injures winter grain. When melting snows and heavy rains from without, are added to the same within the field, the soil and plants are but too often washed away, and gullies formed, which greatly injure the grounds: none of which would ever appear if the soil were properly water furrowed.

The same destruction frequently occurs from depending on the plough alone for forming water furrows, and by making no provision for the water to escape across the head lands. These are too generally raised higher than the rest of the field, by the slovenly practice of emptying the plough filled with the soil on them, when, if proper care was taken, so little of the soil would be carried out on them, that a man with a shovel would soon return it back into the field. If this were done, the head lands would be kept clean, and the grasses growing on them might be mowed, and fed green to the cattle, or made into hay; but to return. When the water in the furrows is opposed by the heights in them, which always occurs either from rising grounds or obstacles which the plough cannot effectually remove, it is forced back and runs over the lands. Thus, the whole of it accumulates at the lower parts of the field, and is either backed in upon it and drowns the plants, or finding a passage by which it may escape, spreads destruction through the course it happens to take. Although this and all the evils from an excess of water from rain, &c. may be readily avoided; and with much less labour than is generally supposed.

To illustrate this, I well remember to have sown four acres with barley. The soil had been greatly swept away in consequence of the water being stopped by a high head land through which it ought to have passed. The lands were but of a moderate width; and although but few obstacles obtained, such as stones, roots, &c. still there were some. Yet a man, (and by no means an active one either,) completely cleared out and regulated the whole of the water furrows in the course of half a day. He also formed cuts at proper places to let the water through the high head land; and drove down

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at the outside of those cuts, stakes to prevent pigs, &c. from getting into the field.

Still I have never seen either shovel, mattock, or axe used to regulate and clean out water furrows, but by two farmers; and except in their practice but one field, either of winter or summer grain, that had been properly water furrowed. This was done by a cultivator from England, who also sowed two bushels of wheat to the acre. He was an excellent farmer; but of the old school: consequently, he prepared the soil for wheat by a naked fallow; which was well executed: of course grass and weeds were subdued. The loss of the valuable animal and vegetable matter by this practice, was, no question, very injurious to the general improvement of his grounds: still it was not felt by the wheat crop. He formed a compost with dung, soil and slaked lime. When this (according to his opinion,) had been well prepared, it was spread over the clean fallow grounds, and ploughed under for the wheat. This not only enriched, but also kept the soil open and mellow; therefore the product was considerable.

He, however, never failed to have plentiful crops of weeds among his wheat. Thus it appears that the fermentation of dung, even when assisted by slaked lime, was insufficient, in his practice, to kill the seeds of the weeds contained in the dung and litter mixed with it; although some gentlemen say that fermentation alone will destroy them.

The general neglect of proper water furrowing in this country, is actually a disgrace to the agriculture of it. The injurious effects of this inconsiderate piece of negligence are obviously seen in almost every field of grain we pass. Unless the formation of the ground, or its texture, be peculiarly calculated to prevent the consequences arising from this ruinous and too general neglect.

If a correct estimate could be formed, of the immense number of bushels of grain, which are annually lost by this unpardonable carelessness, it would so far exceed the bounds of credibility, among those who have given but little attention to the subject, that but few would believe it possible.

Observation, however, would soon convince any gentleman who travels, of the melancholy truth of this fact. He would not only see what has been described above, but also whole fields ruined by gullies which originated solely in the neglect of proper water furrowing. Many of them are destitute of fencing; being no longer worth cultivation, without first encountering an expense nearly equal to the value of the land, even if it had not been so abused.

He would also see that parallel water furrowing was generally practised without cuts across the lands, or any other provision made to counteract their effects. Even when that mode of management was exactly calculated to inundate the field, destroy the produce, and sweep away the soil.

Clover and other grass lays compel this form of water furrowing,

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Still cross cuts in proper directions, and at proper places, would effectually prevent any evil from them.

Farmers, however, seem generally to prefer suffering all the injuries which have been described, rather than encounter the rational labour of properly water furrowing their fields.

If ridges have been formed for the fallow crop, it is still necessary, after the small grain has been sown, to open proper furrows across the lands, wherever the water would become stagnant; the whole of the furrows should be also cleaned out, and properly regulated, to run off the excess of moisture, more especially if winter grain be sown.

When ridges are not necessary for the fallow crop, and the small grain is not sown on a grass or clover lay, the cultivator should attentively view the grounds, and after the small grain is sown, open a sufficient number of furrows in such directions as are best calculated to run off the superfluous moisture, without observing any uniformity in the course of them. It matters not, if they be even serpentine, provided that form should be best calculated to run off the water with the least labour and expense. Although a sufficiency of fall is requisite, too much will certainly form gullies, and also wash away the soil; this is the principal reason why the sides of hills and declivities are so soon impoverished; the furrows are too generally formed up and down them, and although some form them along the sides of the hill, it too often happens that this is done wrong. If the furrows have too much fall, gullies will be formed in them, and if the fall be too little, or none at all, as sometimes happens in part of them, while in other parts, the fall is quite too great, the water will find its way over the field and form gullies in it. The farmer too often, in forming his furrows along the side of a hill, pursues a straight course, without duly considering that the inequalities in the surface, require, that his course should be governed by them, or the fall in the furrow will be far from being regular.

When furrows are formed along the side of a hill, care should be taken, to turn the furrow slice toward the lower side of it, lest the water break over; when it is found necessary to go twice in the same furrow, the plough should return empty, rather than turn the furrow slice up hill.

It is far better to make too many than too few water furrows along the side of a hill; I have observed, that when the furrows were sufficient to run off the water from the usual fall of rain, that unexpected torrents have formed gullies in the furrows, and by running over them done great mischief in other parts of the field.

It should also be recollected, that when these very heavy rains do not occur, the quantity and force of the water is augmented, in proportion to the distance between the water furrows, and that this alone tends to wash the soil downwards.

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CHAPTER XVII.

The exhausting properties of maize compared with those of turnips and potatoes. The five original corns commonly used for field planting described; also the mixed varieties formed by them. Observations on the Canadian and other corns still smaller; also on the red, blue and purple corns. The advantages to be derived from mixed varieties of maize explained; also the best way to effect this purpose. Improvement in plants is more readily effected than the same is done in animals. Climate alters mixed varieties of corn greatly and very generally without its being observed by the cultivator. Those who live in inhospitable climates, should select their seeds from climates which are most like those in which they reside. The advantages to be derived from early sowing and planting in cold backward climates. Local causes alter climates so much, that neither latitude, nor height, nor the influence of surrounding seas can determine the proper time for sowing or planting. No reliance can be placed on the Indian rule for sowing and planting. Observations on the frosts which sometimes take place in high latitudes in August; also, on the means to be taken to avoid any very serious injury from them. Maize is well calculated to withstand drought, and to contend with an impoverished soil. It gathers much of the nutriment by which its fruit is perfected from the atmosphere. Remarks on the diseases to which the corn plant is subject. Observations on the untimely frosts, &c. which happened in 1816.

As there is no fallow crop as highly interesting to American husbandry as maize, I consider it best to refute the prevailing error, that it is peculiarly exhausting, before I describe the proper cultivation of the fallow crops generally grown by us. To do this effectually, it seems necessary to describe the economy of this invaluable plant; although it is said to be a native, still its properties do not appear to be well understood.

It certainly requires considerable nutriment, for it is capable of producing much more food for man, and domesticated animals, on any soil, be it rich or poor, than any other plant known to us; but notwithstanding this apparently exhausting property of maize, all the grain may be sold, and the fertility of the soil increased, if the fodder and stalks of the plant be properly applied.

The fodder from the tops, blades, and husks of a luxuriant acre of corn, is equal to the first crop of an averaged acre of grass, for feeding cattle. The stalks may be considered equal, if not superior to the straw from an averaged acre of wheat, for littering the cattle yard.

I have weighed the dry fodder of maize grown in a mixed crop with potatoes, which yielded at the rate of sixty-six bushels of shelled corn to the acre. It amounted to one ton, six hundred and thirteen pounds gross, viz. blades, husks, and tops. The stalks weighed one

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ton, seven hundred, also gross; and no question but an acre occupied by corn alone would produce more.

Mr. Watson, near Philadelphia, has for several years grown very large potatoes without manure, on thin pasture grounds fed bare. He informed me the intervals were eighteen inches; the sets twelve inches apart in the rows; that the plants were thinned early, suffering but one to grow from each set; that they were earthed up but once, and after this kept free from weeds by the hand. The produce he estimated at one hundred and fifty bushels to the acre; and said they were followed by rye, as the grounds were too thin for wheat.

This seems to be severe cropping; however, it shows the great value of grass lays; also the advantage which may be derived from arranging plants so that sufficient room be preserved, both in the intervals and along the rows, for their roots and tops: likewise from thinning them to such numbers as the soil is capable of perfecting.

The very ingenious J. Tull grew large turnips on thin soils without manure by drilling them. He left wide intervals between the rows, and thinned the plants so that they did not incommode each other. The grounds were well pulverised and kept free from weeds. His crops, if I recollect right, were by no means inconsiderable, when it is considered that he grew them without manure.

As too few farmers read books on agriculture, there are not many of them who know, that turnips and potatoes will produce crops worth gathering, without manure, unless on fresh or very rich soils. They of course cheerfully apply it for these plants; and finding that small grain grows very luxuriantly after them, they are believed to possess superior ameliorating properties. While corn, which they well know will grow on very poor soils, if it be planted wide enough apart, also properly thinned and suckered, they too often grow on such grounds, until the soil is ruined by this powerful contender with poverty. When these cultivators observe the destruction occasioned by their own folly, they transfer the blame to the corn plant, which has been faithfully administering to their comfort and wants, while it was possible to contend with an impoverished soil.

We might, however, with equal propriety condemn a general for surrendering a fortress, which he had defended with the utmost gallantry, until himself and his brave troops, reduced by hunger and weakness, were incapable of making further resistance.

The exhausting properties of dissimilar crops are not readily determined. I have planted corn in double rows, on ridges eleven feet asunder, from centre to centre of the double rows. Two double rows of potatoes were planted between the rows of corn, so as to give to each of those plants half the soil. As both were cultivated by the savage practice of ridging up the plants, the communication between the roots of the corn and those of the potatoes, seemed to be cut off.

After those crops were removed, the grounds were sown the same fall, with wheat, on one ploughing, executed in the same direction; the rows of corn and potatoes were planted, and a clearing out fur-

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row formed through the middle of each corn ridge. This seemed to give the potato grounds every advantage. Yet no difference was observed in the wheat or the grasses following it, either where the potatoes and the corn had been grown, although no manure was applied either for the wheat or the grasses following it. It would seem that both the potato and the corn plant, are well calculated to gather much nutritious and fertilizing matter from the atmosphere.

There are five original corns in use for field planting, in the middle and southern states, to wit: the big white and yellow, the little white and yellow, and the white Virginia gourdseed. The cobs of the two first mentioned are thick and long, the grains are much wider than deep, and where the rows of grains meet and unite with each other, their sides fall off almost to nothing. This gives the outside ends of the grain a circular form; and communicates to the ear an appearance somewhat like a fluted column. This formation greatly diminishes the size of the ends and sides of the grains; and is the cause of the hard flinty corns being less productive in proportion to the length and thickness of their cobs, than the gourdseed corn. As the little white and the little yellow are formed much in the same way, and the cobs considerably smaller, they are still less productive than the big white and yellow, but ripen earlier.

The grain of those four flinty corns are very firm, and without indenture in their outside ends. The two smaller kinds seem to be still more hard and solid than the larger; and the colour of the little yellow deeper than that of the big.

The ears of the Virginia gourdseed are not very long, neither is the cob so thick as that of the big white and yellow. But the formation of the grain makes the ear very thick. They frequently produce from thirty to thirty-two, and sometimes thirty-six rows of very long narrow grains of a soft open texture. These grains are almost flat, at their outside ends, are also compactly united from the cob to the surface of the ear, without any of that fluted appearance between the rows of grain, which causes the flinty corns to be much less productive in proportion to the size of the ears.

The gourdseed corn ripens later than any other, but is by far the most productive. It is invariably white, unless it has been mixed with the yellow flinty corns. Then it is called the yellow gourdseed, and too many farmers consider it and most other mixtures original corns. I have often heard of original yellow gourdseed corn, but after taking much trouble to investigate the fact, could never find any thing more than a mixture. If there be an original yellow gourdseed corn, it has eluded my very attentive inquiry from the Atlantic to our most remote western settlements.

The general texture and colour of this mixture prove its origin. Especially as it may be readily grown white, if care be taken to select seed annually from ears approaching in form, texture, and colour nearest to the original gourdseed corn.

The corn which commonly passes for the white gourdseed, is nothing more than a mixture of it with white flinty corn. There-

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fore those who wish to cultivate the original, will have to grow out the other varieties.

So prevalent are mixtures, that I have never examined a field of corn, (where great care had not been taken to select the seed,) which did not exhibit evident traces of all the corns in general use for field planting, with many others that are not used for this purpose.

None can be longer or more readily traced than the gourdseed. If the smallest perfectly natural indenture appear in the grain of the hardest corns, those grains, with their descendants, may be grown, until a perfectly white gourdseed is obtained, be their colour what it may.

In the northerly divisions of the United States, they frequently plant the small Canadian corns.

These are solid and very early, but have been generally thought too small to be very productive, and are seldom planted in fields, where the larger corns ripen.

These corns and others which are still much smaller and earlier, are grown by many for early boiling or roasting while green.

The Canadian corn plant is considerably smaller than the corns in general use for field planting, it is also productive in ears. Therefore the intervals, as well as the clusters in the row, might be closer together. If the soil were as well manured for this kind of corn as is done for the larger corns, (when the farmer is well informed and able to do it,) very valuable crops might be obtained from it: particularly if it were only slightly mixed with the gourdseed corn.

There are also red, blue, and purple corns, but none of these are used for field planting; still having been introduced they too often appear in our fields, either in their native colours or in variegated or enameled grains. The leaves of the plant are also sometimes variegated from the same cause. It is said that a good purple dye is formed by using the purple corns for this purpose; and the stalks and leaves of this plant are purple, or a shade between that colour and green. I have also seen corn with red stalks and leaves, but mixed with more or less green.

As novelty and other causes have introduced such a great variety into our fields, they will continue to appear in them until farmers generally give more attention to the economy of maize, and see the necessity of growing out inferior kinds, so far as it may be practicable. Although they may be divided almost ad infinitum, they cannot be entirely eradicated. They may, however, be readily reduced and kept under, so as not to do any material injury to the crops, provided the cultivator very carefully and annually selects his seed. It may be from the latent remains of these mixed varieties that nature, from combining causes, sometimes produces plants and animals, more perfect than the class from which they sprang.

This variety as it regards corn proceeds from the farina fecundans, a light minute substance of a mouldy colour, seen on the clothes of those working among the plants, when it is disengaged

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from the tassels. This is wafted far by high winds, and is the cause of distant and unthought of mixtures. However, in general it is lightly and plentifully diffused through the field, and lodges in sufficient quantities on the silky fibres which project from the ears. A single fibre proceeds from each grain. This has been so constructed as to convey the principle of *life* contained in the farina fecundans to the grain from which the fibre springs, even to the further end of the cob. This is done with so much certainty that we rarely see abortive grains, when the plants have been rendered healthy and vigorous by a sufficiency of nutriment and good cultivation. The change produced by this mysterious cause is generally gradual. We first see scattering whitish looking grains on the ears of the yellow corn growing among the white, and the reverse on the ears of the latter, when grown near to the yellow corns.

The foregoing facts have induced me to make experiments. The result seems to determine, that if nature be judiciously directed by art, such mixtures as are best suited for the purpose of farmers, in every climate in this country where corn is grown, may be introduced. Also, that an annual selection of the seed, with care and time, will render them subject to very little injurious change; provided the desirable properties of any of the various corns be properly blended together. They do not mix minutely, like wine and water. On the contrary, like mixed breeds of animals, a large portion of the valuable properties of any one of them, or of the whole five original corns commonly used for field planting, may be communicated to one plant; while the inferior properties of one, or the whole, may be nearly grown out.

In doing this, it would seem that the colour of this mixture may be either the purest white, or a yellow, nearly, or perhaps quite, as deep and bright as the colour of the flinty yellow corns: also, that the economy of the plant formed by these mixtures may be rendered sufficiently early to ripen in any climate that is not very unfriendly to the later corns, either from powerful local causes, or from being very far north. For climates which are more favourable, a mixed variety may be formed which will be much more productive than the corns which are at this time commonly grown in them.

We may frequently see ears that ripen early, possess more of the valuable properties of the late and larger corns, than others in the same field, and grown from the same kind of seed that ripens later. We may also observe some ears with long yellow grains growing on them, and other ears growing on the same field, which produce pale, yellow, short grains, although grown from the same mixture of seed. Notwithstanding the gourdseed grows and ears higher than any other variety, still we sometimes see, when it is mixed with the flinty corns, that some plants will grow, and also ear, much lower than others.

Almost every desirable property in domesticated animals has been lately obtained by judicious breeders of live stock. It would seem

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that corn which would admit of an annual improvement, offers a better prospect of success in this way than animals.

When this object is obtained, and we become acquainted with the proper arrangement of the plants in our fields, so as to promote the utmost product, the crops of maize will by far exceed any estimate which would at this time be considered probable by those who have not carefully examined the economy of this plant.

It should, however, never be forgotten that a sufficiency of nutriment and good cultivation are quite as necessary to increase and perpetuate the size of grain, as plentiful and nutritious food, and proper care and management, are to accomplish the same in animals.

My ears of maize are now at least one-third larger, on an average, than were the ears procured three years ago from Huntingdon for seed. The same may be also said of some white, flinty corn, procured by my neighbour, Mr. H. Philips, from near Erie, for seed. The grain of the spring wheat, which has been sown in the better grounds here, and well cultivated, is vastly larger than was the seed first procured, or is the same grain grown here on impoverished or badly cultivated soils. It is not locality, but bad cultivation, a poor soil, and slovenly farmers, that degenerate seeds.

They are invariably improved in the hands of an attentive cultivator, who carefully grows, or picks out such mixtures as he does not approve. Still some gentlemen who ought to know better, advocate change. However, in general, a much better and speedier change in the properties of animals and seeds may be effected by the introduction of foreign aid, through the medium of mixture. Consequently, the theory of breeding in and in has been carried too far. This error may have proceeded from the cattle jockies, who, while they were slyly making speedy alterations, both in the size and form of animals, by foreign aid, were picking the pockets of the inconsiderate gentleman farmer by amusing him with ideas which are certainly inconsistent with actual practice. But to return to the economy of maize.

The quantity of the gourdseed corn mixed with the flinty yellow corns, may be determined, so as to answer the farmer's purpose. When the proportion of the former greatly predominates, the grains are pale, very long and narrow, and the outside ends of them are so flat that but little of the indenture is seen. As the portion of gourdseed decreases in the mixture, the grains shorten, become wider, and their outside ends grow thicker. The indentures, also, become larger and rounder, until the harder corns get the ascendancy. After this, the outside ends of the grains become thicker and more circular. They also grow wider, and the fluted appearance between the rows increases. The indentures also decrease in size until they disappear, and the yellow, flinty variety is formed. But, as I believe, not so fully but that the latent remains of mixture will forever subject it to more or less change.

It is more difficult to determine the quantity of big and little

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yellow corns, which may happen to be mixed with the gourdseed; and at the same time with each other. However, by attention, a tolerably correct opinion of this may be formed. The grain of the big yellow is much wider, and nothing like so deep as that of the gourdseed; and although the grain of the little yellow is not so wide and deep as that of the big, still it is wider than the gourdseed; and its colour is deeper than that of the big yellow, and its cobs are much slimmer, as well as shorter.

When a mixture with the big yellow and gourdseed is desirable, care should be taken, in growing out the little yellow, to preserve as much as possible of the deep yellow tinge and solidity communicated to the grain by this variety, and also of its property to ripen early.

The soft, open texture of the gourdseed renders it unfit for exportation, unless it be kiln dried. This has given rise to an unfounded prejudice among the shippers of this grain, in favour of the yellow corns, although they are not more solid than the white flinty varieties. However, while this prejudice continues, it is best for those who depend on selling it for shipping, to mix the gourdseed with the yellow flints, and for those who consume the produce on their own farms, or can readily sell the white corns, to form mixtures with them and the gourdseed. It is thought that the white corns are the most productive, and ripen earlier than the yellow; but of this I know nothing certain, having generally grown the yellow. There can, however, be no question but that the white furnishes much handsomer meal for culinary purposes. It is also free from that strong taste so readily distinguished by those who have been accustomed to use the white; but as most of the Pennsylvania farmers, and cultivators still further north, have been used to eat the yellow, and habit causes most kinds of food to become agreeable, they seem generally to prefer the strong taste of this variety to the much milder and pleasanter taste of the white. However, in the countries where neither is grown, and to which it is often exported, there can be but little doubt that the white would find a readier market, and that the demand for this very nutritious grain would greatly increase, if none but the white were exported: especially, if laws were passed prohibiting the exportation of maize until after it had been kiln dried.

I believe there is no grain that will keep longer or safer than corn, if it be kept on the cob in open dry cribs, and the climate also be dry, unless the weevil be introduced by not carefully cleaning the cribs of every vestige of the old grain and vegetable matters introduced with it.

Flinty corns, after they have been well dried in such cribs, may be shipped in tight, dry vessels, with tolerable safety, to the West Indies: but longer voyages subject this grain to greater injuries, although it may arrive at port in tolerable safety; a little damp communicates a musty taste to maize, and if this does not happen,

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it is often spoiled by lying in bulk after it arrives, and will be considered much less valuable on this account.

Either the big yellow or white should be mixed with the gourdseed, for planting in every climate where this mixture will certainly ripen. Their cobs being very long, and the grain so much wider and deeper than those of the little yellow or white, the mixture with them will be much more productive. It is also thought, that the length of the ear communicated by the big yellow or white, will fully compensate for the shortening the grains of the gourdseed: therefore, if the mixture be properly formed, its product may even exceed that of the original gourdseed corn; I have measured the product from ears of this mixture, which, when shelled, yielded a full pint of corn, after they had lain twelve months in a very dry place, although the mixture had not been well improved.

The little yellow and white, being earlier than the big, they should form mixtures with the gourdseed corn for being grown in climates more unfavourable for maize. But whoever may form either of those mixtures, will find, that he must grow out either the big or little flinty corns, with many others, as they are more or less mixed.

The speediest and best way to form either of those mixtures, is to select one ear that may possess most of the desirable properties united in it, and to plant the seed where the farina fecundans from the general crop cannot readily obtain access. If it happen to the cultivators, as it has done with me, he will certainly find from the growth of this seed many ears in his patch, very much like the ear that grew the seed, and many very unlike it; however, it may be that he will find some ears approaching nearer to the variety which he wishes to form than the original ear; if so, he will of course select the best, and go on in the same way, until he has full enough for planting his general crop. After this, he should aim at an increased improvement, by carefully selecting his seed annually for the ensuing crop.

It is too commonly believed, that corn growing on slim cobs, is more productive than that grown on thick ones; nothing can be more repugnant to common sense and observation; for on the same principle they might believe, that a small surface of soil would produce more than a larger one; yet if the ears of the slim cobs are much longer, or the grains considerably deeper than the corns producing thicker cobs, the product from the slim ones may be more to the acre. I have, however, never seen either of these causes produce this effect, except in the gourdseed corn, for its cob though not so small as that of several other corns, is smaller in proportion to the length of the grain than any of them.

Doctor Logan, and Mr. Joseph Cooper, both farm in the vicinity of Philadelphia; the corn grown by them, has been planted here, and did not ripen; this failure puzzled me exceedingly at first; as corns partaking quite as much, or perhaps more of the gourdseed, became ripe, though planted at the same time, and in the same soil.

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I have, however, since seen the cause; farmers every where generally plant too late; even in the neighbourhood of Philadelphia, corn is sometimes ruined by frost, from this cause alone.

In colder climates or situations rendered cold by local causes, it is very frequently destroyed, or greatly injured; although in these situations, the little yellow or white is commonly planted; when in many of them the larger corns would prosper, if proper management prevailed.

The injury from frosts falls heaviest on the plants that ripen the latest. When the farmer selects his seed, he naturally rejects the injured ears, and the largest ears only of that variety, which may be preferred by him, are laid by for that purpose. As early ripening is not in every instance confined to the smaller or less productive ears, when the seed is composed of varieties, mixed, or blended together, either by art or accident, the farmer, without knowing any thing of the cause which produces the effect, gradually alters the economy of the plants to suit the climate. As this selection is commonly made annually, especially if the farmer suspects that frost has injured the vegetative powers of a part of his crop, he is sure to obtain the largest sound ears, and at the same time an earlier variety, than that part of his crop which had been injured by frost.

It would also seem, that this accidental mode of selecting seed in more northerly climates, diminished the height of the plants: also, the height of their earing, if grown from mixed varieties. As high growing plants are the most disposed to grow later ears, the injury from frost falls heaviest on them, and they are diminished, and although low growing plants are far less disposed to furnish large ears, still this sometimes happens, and when it occurs, they generally ripen early, and are not injured by frost.

The corns had from Doctor Logan, and Mr. Cooper, as well as from Ohio, and various other places, where the grounds lay much lower than they do here, have invariably, so far as my observation extends, grown and eared much higher than corn growing beside them, which had been accommodated to our climate, although the latter seemed to partake quite as much, or perhaps more, of the useful properties of the gourdseed corn.

The foregoing facts should teach those residing in the colder climates, to procure their seeds, when practicable, from climates not warmer than their own. When the best kinds cannot be got in this way, they should sow and plant their general crops with seed known to prosper, and use the better seeds had from warmer situations sparingly and carefully, until they become accommodated to the climate, or until it is found that they will not prosper in it.

This practice may be also very useful to those who live in, or are about to remove to an inhospitable climate, where but little valuable vegetation grows.

If seeds be selected from a country, the nearest approaching to the one they now mean to inhabit, or in which they already reside, it is

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more than probable they would succeed. Notwithstanding they might not be equal to the same plants grown in better climates, still they would be invaluable where no better could be had; and time might enable the cultivator or his posterity to grow much better. For after the better plants had been, either from design, or accident, gradually and frequently removed still further north, though climates opposed to their natural habits, they might in the course of time be habituated to withstand even the severe cold of very high latitudes.

It should, however, be remembered, that where the seasons are short, planting and sowing as early as frost will permit, is of the utmost consequence. The contrary practice has completely excluded many valuable plants which would have produced abundantly, if farmers had not considered it necessary to postpone planting and sowing, until the grounds were, agreeably to their opinions, sufficiently warm. This is a fatal error, especially as the ground is frequently warmer, and the soil better calculated to promote vegetation, in the more early part of spring, than it is at the remote periods they fix on for planting and sowing. After the plants have taken root, many kinds which are now considered very tender, are nothing like so susceptible of serious injury from frost as farmers and gardeners too generally suppose. If they should happen to be destroyed, they may often be resown or replanted, in time to stand on an equal footing with those planted or sown at the usual time. But this labour and expense may be generally avoided, by observing what degree of frost the plants will bear without material injury, and the time in the spring, when, in the common course of events, such frosts are not to be expected.

It is thought that the spring opens ten or fifteen days later here, than in the vicinity of Philadelphia, where I resided several years previously to my removal to this place early in June, 1812. Still I plant corn here, much earlier than it is planted there, to wit, from the 23d of April to the 1st of May, as the season may happen to suit. From the 10th to the 15th of May, was the common time of planting in the neighbourhood from which I removed, but some planted much later even than this, as it too often happened that cold rains or other causes, determined them to wait until the ground was warmed.

When I planted my corn on the 1st day of May, 1814, a few clusters had been planted by a neighbour in his garden, on the 9th of April. These plants were in general cut off two or three times by frost, yet they maintained a superiority over the corn planted by me on the 1st of May, until the growth of the peas and beans planted quite too close to the maize, greatly injured it. As there had been a hog pen in one end of my patch, it was very clearly seen that superiority of soil was not the cause of this marked difference.

When corn is planted very early, it is commonly severely affected by frost; so much so, that many of the plants are cut off by the ground. This is unquestionably an injury to which no judicious farmer would expose the plant, if the advantages obtained by very

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early planting, could be had by planting later. Still if the roots remain unhurt, they are of consequence established, and very soon repair the injury done above the soil, after the frost ceases to act on the plants. Of course they take the lead, and will maintain their superiority over later planted corn. The ears also fill and ripen much better in northerly climates from this practice.

The shooting and filling of them take place when the heat of the sun is much greater; and when less cloudy, cold, dripping weather prevails, and the crop is nothing like so liable to be injured by frost. The grounds are also sooner ready for crops sown in the fall. This mode of management will often enable the cultivator to grow the large and more productive corns, in climates where they have been abandoned, from observing that they did not ripen when planted at the usual time.

When I introduced the large yellow gourdseed corn, from seed procured from Huntingdon county, every farmer here ridiculed the idea of attempting to grow corn of this description. They considered the soil and climate hostile to the growth even of the smaller corns, and but little was planted. As they waited until the earth was warmed before they planted, the crops were frequently either destroyed, or greatly injured by frost.

I had, however, seen the effects of early planting, and knew that these men had been more or less conversant with it ever since they had been old enough to assist in the labour done on a farm. They were ignorant of the properties of maize, merely from not having sufficiently considered that a farmer ought to endeavour to become acquainted with the economy of the plants cultivated by him.

If they had thought of this, they might have seen that the corn planted by them, and every body else, for growing early roasting and boiling ears, was generally put into the ground much sooner than that planted in fields. Also, that the corn planted for early use always succeeded, unless the roots were materially injured by frost; and that this seldom happened: as actual and long continued practice in their gardens had taught them, that it was unsafe to plant for this purpose until material danger from frost had passed by. For although gentlemen who keep gardeners, and those who grow early corn for market, plant the very early varieties for green corn, farmers very often plant the same kind which is grown in their fields.

As it seldom occurs that the whole of the ears are pulled off when green, practice, in his garden, might long since have taught the farmer, that early planted corn, in cold, backward climates, eared and filled much better than corn planted at the usual time: also, that the causes of this were more sun, less cold, cloudy, falling weather, and frost, during the shooting and filling of the ears, and the hardening of the grain. The natural conclusions drawn from those facts, if they had been duly considered, must have been that the same good effects would occur in their fields if the same practice were pursued: also, that by early planting they would

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avoid that destruction of their crops which so often occurs in high latitudes, merely from planting quite too late.

Notwithstanding these very interesting facts have been as obvious ever since corn has been planted by Europeans and their descendants in this country, I do not recollect ever to have heard any thing said, or to have seen any thing written, on this subject.

Local causes alter climates so much, that the only sure criterion by which we may determine how soon corn or other seeds may be planted in many neighbourhoods, is to observe when, in the general course of events, this may be done without risk of any material injury from frost. The ridge of quite a low mountain, or, indeed, the ridge of a high hill, will make a difference of several days in the proper time of planting or sowing in the valleys on the opposite sides of them; although these valleys be not more than two or three miles apart. Other causes, also, produce similar effects.

This shows the very great advantages which would be derived if intelligent farmers, in every neighbourhood, would take notes on the weather, and its effects on vegetation.

Neither latitude, nor height, nor the influence of surrounding seas, can determine this subject sufficiently correct for agricultural purposes.

No kind of dependance can be placed on the Indian rule for planting or sowing. It may be of some use to them, whose observation is limited greatly by savage ignorance, but of none to us. We sometimes see the same vegetation which usually takes place in May, about the time corn is commonly planted, occur in February, or the fore part of March; when no rational cultivator would plant corn in any part of Pennsylvania where I have been.

The corn plant is easily destroyed by frost in the fall, being then debilitated by age, or exerting all its powers to perfect its fruit. But when young, it is much hardier than is generally supposed. I have observed it for several days together coming up through the heat of the day, although the surface of the soil had been slightly frozen in the morning.

The spring after I removed to this place, Dr. Dewees, with Mr. Philips and myself, planted the yellow gourdseed corn on the 30th of April and the 1st of May. The season continued sufficiently mild to establish the roots of the plants, although many of their tops were severely affected by frost, and some of them cut off nearly level with the ground. The weather, after we had planted, was not quite so favourable, and continued to be such as farmers too generally consider unfit for planting maize.

Forty or fifty miles around us, (except two fields in this neighbourhood, which the cultivators planted earlier than usual,) but little corn was made: a great many fields were of so little worth that scarcely any grain was gathered from them, although the two first mentioned crops were considered excellent by all who saw them.

Farmers attributed this failure in their corn crops, to a continuation of wet, cool weather, through the spring and fore part of the

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summer, joined with a severe drought in the latter part of the season. But as the two luxuriant fields mentioned above were subjected to the same events, I can see no cause for this marked failure in the crops generally, except procrastinating planting until the earth was thought to be sufficiently warmed; which did not happen until it was too late to grow even the smaller corns with tolerable advantage, unless the latter part of the season had been very favourable.

No rain fell on my field from the 30th of July to the 1st of September; during which time moisture is particularly required in this climate, to fill the ears: yet I had never grown better ears before.

If the farmers had planted as early as I did, and cultivated their fields well, no question the same would have occurred in their corn crops; for the economy of this invaluable plant is well calculated to withstand the severest drought.

My field of corn, planted last spring, (1815,) with the same kind of seed, on the 24th and 25th of April, was doomed to withstand much severer frost than that just mentioned.

On the 15th and 16th of May the ground was frozen so hard that I peeled off the soil in cakes, to nearly, if not quite, three-quarters of an inch thick, and observed loose particles of congealed moisture still deeper than this.

Many of the plants were cut off by the ground, and yet I have never grown so large a crop of maize. It was still more remarkable, that some of the plants which were growing from seed, that by inattention was scarcely covered with soil, were not destroyed. It would appear that the earth screened the roots from the too powerful effects of the sun, and that a gradual thaw preserved them from injury.

Beside the early and later frosts, high latitudes are subject to a frost that sometimes takes place from the 20th to the latter end of August. This, when it happens to be severe, injures buckwheat and maize exceedingly, and sometimes entirely destroys those crops, when planted in low bottoms.

Their severity at this season of the year seems to arise from the preceding heats, by which the air is so much rarified that it would appear the consequence is a gust from the northward. This introduces torrents of cold air so suddenly that its temperature can be but little altered by passing through milder regions than those from which it proceeded; and the effects are sometimes as fatal as they are sudden.

When the atmosphere has had its temperature reduced by those, or milder means, there appears to be but little danger from severe frosts. Not only so far as my limited observation extends, but also from what I can learn from those who have lived here more than twenty years. They calculate on a moderate fall if the August court, (which commences in the latter part of that month,) passes by without injury from frost. As in that case frost seems

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to be gradually introduced, as in warmer climates, by the seasons advancing.

I expect the effects of this frost would be generally fatal in very level valleys, surrounded by hills. In a country where gentle hills and dales prevail, it is not so much to be dreaded, if the farmer manages properly.

I have seen corn and buckwheat on but moderate elevations, so little affected, that it required scrutiny to observe the traces of frost among the crops, while other crops of the same description growing in bottoms, and but a little distance from them, were either ruined, or sadly injured.

Cold, heavy air, like water, rushes down from the heights and inundates the bottoms; still, if considerable creeks or rivers run through, or pass by the bottoms, the crops are often preserved by the warm exhalations arising from the water; this with the fogs that are generally caused by the moisture, warms the air, and prevents frost. When these causes are not sufficient to prevent it, the fog frequently obstructs the rays of the sun, until the frozen plants are gradually thawed; by which means they are often saved from serious injury.

The most severe and injurious frost of this kind which I have seen, or that has been known by the oldest settler here, to have happened, was ushered in by a gust in the evening, on the 21st of August, when the ground was quite dry, with but a sprinkle of rain, and the sun shone clearly the next day.

This induced me to believe, that if considerable rain had accompanied the gust, the warmth of the earth at this season of the year would have produced sufficient vapour to have greatly reduced, or perhaps entirely prevented the injury sustained in the bottoms by this frost.*

The mixed crop of maize, and kidney bunch beans, which will be hereafter described, was at this time growing on a flat of ground, with a hill and flat above them. They sustained no injury, except the drooping of the points of some few of the leaves of the corn; while buckwheat growing on a bottom directly opposite, and not more than twenty perches distant from the corn and beans, was nearly destroyed.

No maize was injured by this frost, except one field of yellow gourdseed corn, planted rather too late, and in a low bottom; this

* This opinion seems to have been in some measure confirmed from what has since happened. On the 25th of August, 1817, considerable rain fell, accompanied by a gust from the northward, which introduced torrents of cold air. On the ensuing morning I observed ice formed in some milk crocks standing on a very low shed in my back yard; also, that ice had been formed on, and greatly stiffened some of the leaves of the corn growing in my garden; likewise, that the fog arising from the exhalations from the earth had condensed on the fence rails, and the roofs of the houses, in sufficient quantities to cause them to look as white as they would have done if a slight snow had fallen. The sun dispersed the fog at a very early hour, but not before the most of the frozen plants were thawed, consequently no serious injury was done.

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was much hurt, still there were some fine ears which escaped without injury. This goes far toward establishing the theory, that frost greatly assists the farmer in cold climates, in the selection of such seed as suits his purpose best.

I am induced to believe, from what happened in consequence of this frost, together with the same partial damage done by the same frost in Penn's Valley, and other places not further distant from this neighbourhood, that corn may be readily preserved from any very serious injury from the frosts which may happen in August, if the larger varieties be planted on the higher grounds, and the smaller corns that ripen very early in the bottoms: particularly, as I have seen here an accidental mixture of the gourdseed, with a very early small white flinty corn, which seems to be productive. One of my neighbours brought me an ear of it on the 29th of August, which was hard; it would seem that a variety might be formed from this corn, which would ripen sufficiently early to escape any very material injury from the frost, that sometimes happens in August, if grown in this neighbourhood on the lower grounds. It should, however, be recollected, that this is not to be expected, unless the cultivator plants as early as the season will permit; but perhaps not quite as soon on the lower grounds, as on the ridges, for frost is severer in the spring, as well as in the fall on the bottoms.

The roots and stem of maize spring from the heart of the grain; the former grows from one to two or more inches long, before the latter appears, and progresses so very rapidly, that if pulled up from a loose soil, they will measure about twelve inches long, when the stem is only about three inches high, although their finer fibres must be left in the ground by this rude operation.

The stem protrudes itself through the soil in the form of a bodkin, and is composed of leaves rolled very compactly together; the first two leaves expand soon after the plant penetrates the soil; and other rolled leaves continue to unfold in succession from the crown of the plant, until the tassel appears wrapped up in its own leaves: these also gradually spread themselves, until the plant is fully formed.

The leaves increase in width and length from the ground, up to where the most perfect ear is formed; after this, they decrease in length and width, more rapidly than they increased below, and this decrease is regularly maintained even to the uppermost leaf, which forms itself a little below the tassel.

One leaf grows from every joint in the stalk, but in such a way as to alternate sides; the first formed leaf, and after this, every leaf in regular succession, clasps the stalk closely, until it approaches near to the under side of the leaf above; after this, it grows out from the stalk, and a beautiful fanlike appearance is at length produced, which is not equalled by any other annual plant cultivated for the value of its fruit: especially, when the large luxuriant ears display at their points, elegant tufts of silky fibres, which vary in colour when mixtures form the seed.

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The height of this plant differs much. The smallest variety that has been noticed by me, did not seem to exceed three feet in height. The largest plants which I have seen, measured but thirteen feet. I have, however, heard of some which attained the height of seventeen feet. These must have been grown on a very rich as well as a very deep and open, free soil.

The lateral roots of maize soon spread through the whole soil. The finger roots, as they are sometimes called, dip much deeper. I have seen them traced two feet below the surface of the soil, by a grubbing hoe, in the hands of a rugged workman. How much further their finer fibres might have gone, was not ascertained by me, but this convinced me, that the roots of maize were capable of drawing very much moisture, and some nutriment, from a much greater depth than most of the plants cultivated by us. Also, that these manures and smaller roots, were better calculated to effect this very interesting purpose, than they would have been if nature had formed the whole of them into one single taproot, which extended no deeper. This is one cause among many others, why maize is capable of contending so powerfully with poverty, and withstanding severe and continued drought, better than most other cultivated plants. This should convince us that a plant capable of drawing such important supplies from beyond the range of plants in general, will not prove peculiarly exhausting if it be treated fairly, by having as much manure, or as good a soil appropriated for it, as is commonly used for those plants which farmers in general have not learned to grow on poor soils without manure.

The prop roots of maize appear about, or a little before, the tassels may be seen. They proceed from the joint at or near the surface of the soil. They are numerous, and form a circle round the plant. That portion of them which grows outside of the ground, is hard and woody, similar to the substance which forms the outside of the stalk; but so soon as they penetrate the soil, they become softer, and spread through it in search of nutriment: this is just at the time the plant requires most of it. The tassel and the top of the plants have after this to attain their full size, and the farina fecundans, which impregnates the grain, is to be formed. The ears now begin to shoot, and they are also to be filled and perfected.

The prop roots are exactly calculated to support the weight of the tassels and ears, during high winds, and when the grounds are softened by rain. But farmers too generally thwart this simple but wise arrangement of nature, by hilling, or ridging up the plants. These inconsiderate operations not only cut and rend the roots, but also compel the plants to grow new sets of prop roots, from the joints above. Those seldom get sufficiently established in time to support the weight and height of the tassels and ears; and many of the plants are of consequence blown down, or fall by their own weight alone, when the grounds have been previously much softened by rain.

Maize, from its woody texture, and commanding size, might (with-

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out straining the point very far,) be called an annual bread tree, producing the best of all corns, and at the same time crops, which in magnitude far exceed that of any other grain. Also tops, husks and leaves, which can be readily gathered; and furnish abundant fodder for cattle, equal to the best hay; and independent of this, the stalks supply much valuable litter for the cattle yard.

That part of the leaf which surrounds the stalk, and adheres so closely that it does not permit a particle of moisture to escape, is very interesting. The peculiar insertion of the leaf, together with the formation of that part of the stalk covered by it, forms a cavity for the reception of the rich moisture, which is gathered into it from the atmosphere by the leaves, and for which they are most admirably formed.*

The shoots, which form the ear, commence at the joint in contact with the ground. If the soil be rich or highly manured, they issue from every joint up to where the uppermost ear is formed at the footstalk of the tassel. This last or highest up ear, is almost invariably the largest, and ripens soonest. It seldom occurs that more than two ears are perfected on one stalk, unless the clusters of plants are very distant from each other, and but few plants stand in each cluster. If the plants stand thick on the ground, but one ear is commonly perfected by each of them. The abortive ear shoots are called suckers. These are commonly removed, so far as the farmer considers conducive to the welfare of his crop. This should be done so soon as they are large enough to be pulled off effectually. No part of them should be left adhering to the stalk, or they will grow again from the stub left behind.

If this operation be not early commenced and frequently repeated, they become so numerous and large in fields highly manured, especially if the plants stand thin on the ground, that they are greatly injured. Not only from the loss of nutriment, but also from the many and large wounds inflicted by the removal of them.

After careful experiment in the removal of suckers, I now pull none above the joint in contact with the ground; and would not remove these, if they did not take root in the soil, and by this means become powerful exhausters. Although it commonly happens that several ear shoots above this point prove abortive, no sucker can be removed without injuring the leaf which binds it to the stalk; and so much that it is commonly rendered altogether incapable of conducting moisture. If it be not so extensively injured, the receptacle formed by it is so much deranged by this operation that it cannot retain the slight portion which may happen to be conducted by the leaf into it.

I am still further encouraged to let so many of these abortive ears stand, as I have observed that so soon as nature has deter-

* The highly important and extensive usefulness of the moisture thus gathered into these receptacles, has been explained in my book on Vegetation and Manures, see from page 55 to page 57.

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mined the number of ears, which existing circumstances may enable her to fill, all her efforts are directed to them; and the abortive ones immediately dwindle, and finally wither: and, for aught we know to the contrary, nature may cause them to part with the rich matters they had previously gathered, and apply this nutriment to assist in maturing her favourites.

I trust it will appear from what has been advanced, that in place of abusing this invaluable plant, as an exhauster of the soil, we should consider it the pride and boast of American husbandry, as mathematical demonstration cannot well afford stronger proof than has been produced, that maize gathers a large portion of the nutriment necessary to perfect its fruit from the atmosphere.

Still, it should be remembered that sufficient nutriment, provided in the soil, is absolutely necessary to enable it to do this very extensively. Therefore, "let not what God has joined together, by man be put asunder," by vain philosophical theories and sophistical reasonings. Such as, that the chief use of the soil is merely to support the plants in their proper place, or that cultivation will supercede the necessity of keeping the soil well stored with animal and vegetable matter.

The middle path is certainly the path of reason and experience, and should be carefully and diligently pursued by the practical farmer, leaving those ideal speculations for the amusement of the learned.

There is no corn crop grown by us which is so certain as maize. Its diseases are few, and most, if not all of them, proceed from an inconsiderate cultivation. I do not recollect ever to have seen them so extensive in any field as to do any very material injury to the crop.

It withstands drought and contends with poverty better than most other plants cultivated by us, either for the value of their grain or roots. It may be advantageously grown in any soil fit for cultivation; not excepting blowing sands, or retentive clay.

Still, this crop fails nearly as often as any other; especially in the higher latitudes, or situations rendered cold from local causes. It cannot withstand grass or weeds, and is too generally planted by far too late. The seed is also covered too deep, as well as oppressed with clods, stones, or any other rubbish near at hand, which prevents the plant from coming up. Too little seed is planted to secure a sufficiency of plants, after birds and quadrupeds have taken that portion which even proper vigilance cannot prevent.

When the field has been planted, in place of being guarded, so soon as the first plants make their appearance above the soil, it is commonly left a prey to birds and quadrupeds; although it is well known that some of these intruders will continue to scratch up the plants while a vestige of the seed remains at the roots.

If the corn escape these depredations, birds and quadrupeds attack the ears so soon as the grain begins to harden. In place of defending the crop until it be gathered, too many leave it unpro-

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tected, to be devoured by them, for weeks, and, indeed, sometimes for months after it should have been gathered.

In all the fields of maize which have been examined by me, some plants entirely barren have been seen without any apparent cause.

The fungus appears to be principally occasioned by wounds inflicted during cultivation. The plants commonly bleed from these wounds, and a fungus is formed. This, when in contact with the ear, is certain destruction to it, unless the fungus be soon seen and removed. When it is formed on other parts of the plant, it frequently corrodes them so much that they are incapable of perfecting their fruit. The only remedy known to me is speedy removal, and repeating the operation if the fungus should reappear: which generally occurs. But even this tedious remedy is too often found insufficient. It is, therefore, far better not to create this disease, by mangling the plants, either by the savage practice of harrowing over them, or by covering them with clods, stones, or sods, as is too often done by the inconsiderate mode of hilling or ridging them up. Although many of the plants wounded by these injudicious practices survive, and appear to flourish, even when the fungus is not removed, still, numbers of them become too debilitated to perfect their fruit.

A reddish kind of rust sometimes appears on the leaves, but seldom does much apparent injury to the ears, unless it becomes extensive. However, the same rust sometimes fixes upon the stalks and causes them to decay.

When this is near the ear, or the decay is extensive, the plant produces little or no grain; but I have never seen very extensive injury done by this disease. The cause of it is unknown to me. It may, however, proceed from the bruises and wounds inflicted by an inconsiderate cultivation; especially as the tassel, wrapped in its own leaves, may be seen formed in the plant when it is quite young. Too many farmers think the health and vigour of the plants are greatly promoted by harrowing over them, and mangling their tops while they are young. Also, by cutting and rending the roots of them, provided this be not done after the tassels and ear shoots appear; than which nothing can appear more preposterous.

The foregoing essay on the economy of maize was written before the untimely frosts of 1816 appeared.

The spring, summer, and fore part of autumn in that year, were much colder, and accompanied with more frequent and untimely frosts than had happened since this country was first settled by Europeans. This has caused much speculation, but seems to have terminated in nothing more than it is probable, from the records kept in Europe of similar events, that every part of the globe is subjected to temporary and distressing alterations in climate, from causes which do not seem to be understood. It also seems probable that some such occurrence enabled Julius Cæsar to cross the Tiber on the ice, although this circumstance is quoted to prove that the climate of Italy has been greatly altered.

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Some of the old men in this country confidently assert that great changes have taken place in the climate since they were young. However, it would appear that such alterations as they speak of could not have been effected in so short a time by the causes quoted by them, even if these causes were calculated to produce the effect attributed to them; which, saying the least that can be said of them, seems doubtful.

Still, so prevalent is this theory, that some of the older settlers in this place tell us the climate has been altered since they came here. Although no alteration in the face of the country can justly lead to any idea of this kind, except that in some few places, where the grounds have been more extensively cleared than has commonly happened, the removal of the shelter which the surrounding forest afforded the crops, has caused them to be more frequently affected by frost.

I do not question, but time has greatly altered the constitution, &c. of most of these old men, who speak of alterations in our climate; as I find it has produced similar effects on myself. But I have seen nothing of those alterations in the climate of which too many of them speak; therefore, cannot credit this ideal opinion.

The winters have been frequently very different, so have been the springs, summers and falls. Still on the whole, they seem to be the same as they were, ever since I was capable of making observations on them; with the exception of the year 1816. In that year my corn was planted the 23d of April. The weather proved favourable until the 8th and 9th of May, when it was cut off by frost. It was also, cut off twice after this in May, and once more on the 9th of June.

I will now copy from my diary, the notes taken of the frosts which happened after this, and their effects on my corn, until it was destroyed by them; as I believe these notes and the observations, I shall make on them, will be interesting to those who wish to become well acquainted with the economy of maize. On the 16th of June, it is observed, "the corn is full as high as it was when last cut off by the frost." On the 29th of June, "Ice this morning, formed in a dish on the top of the shed, but there was a fog, and no apparent injury done." "June 30th, cold, and the corn turned sallow." "July 5th, some white frost, but not enough to do serious injury." "July 7th, considerable white frost, but no apparent injury done to vegetation." "July 9th, considerable white frost, but no perceptible injury done." "July 10th, white frost, but not so severe as yesterday." "July 18th, frost in the bottoms." "July 27th, warm; a gust, with hail as large as walnuts." "July 29th, slight white frost." "August 21st, considerable white frost, but no injury expected from it." "August 22d, considerable white frost and ice in non-conductors."*

* The non-conductors here alluded to are either wooden troughs or tubs, or crocks standing on a board, or any other substance calculated to prevent the heat arising from the earth from communicating with the water exposed in these vessels to the open air.

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"August 28th, corn blades in Philipsburg frozen quite stiff; considerable ice on them; ice in non-conductors, one-eighth of an inch thick; corn at Philipsburg greatly damaged, perhaps ruined." "August 29th, more white frost and ice than yesterday, the leaves of Mr. Philips's corn nearly all killed, and many of the leaves of my corn sadly singed, and partly killed, especially in the lower part of the field."* "September 17th, slight white frost." "September 18th, slight white frost." "September 26th, foggy in the morning, with some white frost." "September 27th, our water tub covered with ice as thick as window glass, the earth in the garden a little frozen." "September 28th, much hoar frost, the ground frozen about half an inch deep."

Of consequence, the corn plant was entirely killed, and not a single ear in my field got hard. However, it was pulled and fed to the working cattle, milch cows and hogs, but seemed to afford but little nutriment, and to do but little good. The fodder was set up in heaps, as the effect of the frost kept the stalks soft; the cattle eat nearly the whole of them, with the husks and frosted blades. They appeared to do as well on this food, as they did, after it was consumed, on first crop hay. I would, therefore, advise the cultivator to take good care of his fodder when killed by an untimely frost, especially the stalks and husks.

It is worthy of remark, that as the roots of the corn plant, had become established in the soil, even that debility which must have been occasioned by the tops being so frequently cut off, had not prevented it from regaining, by the 16th of June, the full height which it had lost but seven days before, by being cut off by frost. Also, that notwithstanding the many frosts encountered by it, and the greatly increased severity of that on the 28th and 29th of August, the plant and the ears have generally attained their full size, and the latter were in common well filled with grain, when the plants were destroyed by the severe frost, which happened on the 27th and 28th of September.

There can be little doubt, notwithstanding the unprecedented hostility of the season, that if in place of the large yellow gourd-seed corn, an early variety had been planted by me, that it would not only generally have filled well, but also hardened in time to escape destruction. Also, that if the farmers had planted as early as I did, their crops grown on the higher grounds would have escaped the wide waste of ruin to which they were subjected, for they commonly plant the smaller and earlier corns.

They, however, waited until they believed the ground would be warmed; but, as it very often happens, it was then found, on the whole, not so well calculated to promote the vegetation of the seed, or to establish the roots of the plant in the soil, as it was when, and for some time after, my corn was planted. The natural consequence was a general failure of the corn crop; except near to rivers or

* My field was vastly more favourably situated than the corn in Philipsburg.

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wide creeks, or where the field was uncommonly well sheltered by the surrounding woodlands; and even in such situations, the corn crops are generally of but little worth.

Local causes render Philipsburg, and the cleared grounds adjoining it, much more subject to frost than any other part of the neighbourhood where the ground has been cleared.

A wide bottom commences opposite the town, and runs between four and five miles beyond it, in a north-westerly direction. This bottom was formerly inhabited by beavers. The damming up the water killed the trees; since the dams were cut, the grounds have grown up in grass, bushes, shrubs and low trees. The timber growing on the hills on each side of this bottom, is very lofty. This forms a wide and very deep hollow, which conveys the heavy cold air into the opening on which the town stands. This caused the leaves of the corn grown by Mr. Philips, to be almost all killed by the frost which happened on the 28th and 29th of August; and also destroyed the leaves of his pompions and some few of the vines.

After this happened, it was debated, whether it would be best to cut off the plants for fodder, or to let them stand; the last idea prevailed. It was evidently seen after this, that the silk grew, and believed, that the ears increased in size. Also thought, that if the frosts of the 27th and 28th of September had not killed the plants, and the fall had been favourable after this, that half a crop of grain would have been obtained, notwithstanding untoward causes had procrastinated the planting, until the 8th and 10th of May, and the variety of seed used was not so early as some other corns. It had been accidentally formed, by mixing the big and the little yellow, with a slight portion of the gourdseed corn.

New leaves put out from the pompion vines, and attained nearly, if not quite, their full size, after the first leaves had been destroyed by the frost of the 28th and 29th of August. It was thought that several of the pompions which were growing at that time on the vines had, after this, increased in size; however, those plants were also killed by the frost of the 27th and 28th September.

From these circumstances, and many others, which it would be tedious to relate, I believe the corn plant is not effectually killed, unless it be debilitated by age, or is near the point of perfecting its fruit, until the ground is frozen, and the roots, as well as the top, are more or less affected by frost. Therefore, I would advise the cultivator, not to cut off the corn plant, unless this happens, or he considers the ears ripe enough for the grain to become dry and hard, after the plants are set up into heaps.

Notwithstanding the inclement seasons of 1816, farmers, at least here, do not seem to have had much cause to complain. The winter wheat was better than usual, so were oats; spring wheat, at least equal to any grown here, before or since; there was but one small patch of barley grown in the settlement, and this certainly bore no marks of being injured by the seasons. Flax was better than common. Buckwheat was considerably injured in some situations, but

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on the whole yielded at least half a crop. Potatoes, especially late planted, were considerably curtailed in size, except in situations where they were well sheltered by the woodlands; there would, however, have been no serious lack of them, were it not that farmers, notwithstanding they have been too often seriously admonished by great loss, still continue covering the heaps in which they are commonly kept through the winter, entirely too shallow to exclude frost.

This error is not confined to climates where the winters are uncommonly cold; as the same evil has too frequently happened in every climate where I have resided. On grounds which had not been injudiciously too much exhausted to grow profitable crops of the grasses for hay, there was no cause for complaint. On thin soils it was otherwise, and so it ever will be, unless the seasons greatly favour the inconsiderate cultivator of them. Still too many farmers do not appear to see, that when the soil is not exhausted, and the cultivation is good, the farmer, be his crops what they may, seems generally to control the seasons, and often makes them subservient to him. He has not only very generally a plenty to sell, but when the bad farmer has but little, or perhaps must either buy or starve, he obtains a high price, because the article is scarce; but this is not all, he becomes wealthy, while the inconsiderate farmer has to struggle with poverty as long as he may happen to live; and entails misery on his posterity, by leaving them an impoverished, and most likely a mortgaged soil; also, with what is still much worse than either, habits opposed to the improvement of the grounds.

After the 9th of October, the weather in the fall of 1816 was as moderate, or perhaps more so than usual; December was uncommonly mild, so much so, that my cattle and horses, except when working, were kept in pasture until the 9th of that month. As the grass of the second crop had been reserved, until it attained nearly its full growth, they might have been generally kept in pasture until some time after Christmas, for the snows were very light, and soon melted away. However, as a light fall of snow had induced me to put them to dry fodder on the 9th of December, and the pasture lay near two miles distant from where they were housed, and the weather at this season of the year is very uncertain, it was thought best not to turn them into pasture again. The weather continued to be very moderate until the 9th of January, when it became very cold, and it continued generally so, throughout the remaining part of the winter of 1817.

We are, however, told of winters still more severe in Europe. "In the great frost in 1683, oaks, and ashes, and walnut trees were cleft in two, and frequently with a terrible noise, and not only their bodies, but their branches and roots also. In 1708, the frost was almost through all Europe, except Scotland and Ireland. All the orange trees and olives in Italy, Provence, and many other countries perished, and all the walnut trees in France, with an infinity

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of other trees. In England, most of the bay trees, hollies, rosemary, and even furze, perished. The sap also of wall trees stagnated in the branches, and produced disorders resembling chilblains; and the very buds of the finer trees were quite killed, and turned into a kind of mealy substance.

In 1728, toward the end of November, the wind blew exceedingly cold, followed by so heavy a snow, as in one night broke off large arms of many evergreen trees. At this time, also, there was a great number of large trees disbarked. Two West India plane trees, in particular, in the Physic-garden at Chelsea, which were near forty feet high, and a fathom in circumference, were disbarked almost from the bottom to the top, on the west side of the trees; and it was observable, that whatever trees were disbarked, it was on the west or south-west side.

On the 14th December, 1759, there was at Petersburg the most excessively cold weather that ever was known, even to 205 degrees of De Lisle's thermometer.*

When a country is generally covered with timber, much of the heat is accumulated during the warm spells which take place in the winter, and confined in the open space which exists between the bodies and branches of the larger as well as of the smaller trees and shrubs which grow on the grounds. This is not, however, so perceptibly felt by us on our first entering the forest, where the timber, shrubs, &c. which happen to prevail, are of the deciduous kinds.

Here the timber and shrubs are generally evergreen. The clearings are small in size, and the number of them inconsiderable. When I have left the clearing in which the town stands, soon after a change from heat to cold had taken place in the winter, and entered the adjacent forest, through which I often daily passed on my way to my farm, I have frequently felt just the same as I have often done after leaving the cold air and entering into a cellar. After a warm spell has greatly moderated the air in the cleared grounds in the winter, the contrary effect has been as perceptibly felt on entering the forest.

Now, we all know that cold and hot air mix and form an equilibrium as soon as this can be conveniently done. Of course, whenever the air is either colder or warmer in the forest, it will be continually rushing into the different air existing in the clearing, until an equilibrium is obtained. It would, therefore, seem, that where forests abound, the air can never be either so hot or so cold in the clearings, as it will be when those extensive forests are removed. Consequently, it would seem, that in place of our winters becoming more mild when the forests are cleared, they will be more severe, especially in our maritime country, on the east side of the Allegheny, as there the cold north-west and north-east winds generally prevail through the winter and early parts of the spring; and, it would ap-

* See Wesley's Phil. vol. i. p. 425.

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pear, will become more severe in consequence of the removal of the forests, which now oppose a considerable proportion of their force. To illustrate this, I beg the reader to refer to where I have explained how a trivial local cause greatly increases the severity of the frosts in Philipsburg, and causes them to act vastly more powerfully than they do in any of the other clearings which have been made in this neighbourhood.

It is, however, readily acknowledged, that the question respecting the changes which may be produced by a general clearing of the country is a difficult one. It can only be determined by time, and by consulting the most authentic records that may have been kept, of the annual state of the weather since the country was first settled by Europeans, and extending (when it may be done) the same mode of inquiry for ages yet to come.

Therefore, my principal aim in discussing this subject *prematurely*, is to rescue it from the hands of the very many old men and old women, who confidently assert that great alterations have taken place in the climate within the very contracted span of their limited observation, although, if the usual allowance be made for untoward seasons, they might have seen that our seed time and harvests have not been altered.

Before implicit confidence, however, be placed in those ideal changes, it should be recollected that old men and old women commonly claim all the superior merit which is so very justly due to a long life spent in the judicious observation of men and things, whether their time has or has not been thus usefully employed.

Hence it is, that we commonly hear old people passing extravagant encomiums on the virtue, modesty, and good behaviour of the youth among which they were brought up, and as extravagantly railing against the fashions and propensities of the present age. Now, if the testimony of these very sagacious old people were to be admitted, from the time the practice of finding fault with the present generation, and praising the past first commenced, it really would seem that the folly and wickedness of man must have increased so fast that nothing but vice and immorality could have long since existed in the world. We, however, find, at least in this country, that in consequence of education being more generally diffused among all the different ranks of our citizens, and with it the precepts of the Gospel, vice hides its deformed head, sculks in corners, and shuns the light more than it formerly did.

My subject, however, puts me in mind of my uncle. He seemed firmly to believe that nothing was as good as when he was young. He even went so far as to declare the peaches were nothing like so good as they were when he was a boy. It, however, so happened, that my uncle was not so much older than myself, but that I very well knew if the same kind of peaches which pleased him so well when he was a boy, were growing in his orchard among the more highly improved trees, from which he could gather none that pleased him, his hogs would not have eaten one of them until after the whole

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of the fruit from the more highly improved trees had been consumed.

It would, however, appear, that my uncle, in the heyday of youth, found enjoyment in every thing from which pleasure could be gleaned. But as he grew older, he became (as too commonly happens) much harder to please, until at length he met with nothing that gave him pleasure, and that he vented his spleen by complaining of the great alterations which had taken place since he was young.

In fact, it would appear that these supposed alterations in climate have been too often referred to by agriculturists as a convenient covering, to hide from the eyes of their too credulous readers the real cause which had induced them to abandon practices in which they had obstinately persisted long after it clearly appeared that they were wrong.

It would, therefore, seem, that notwithstanding it would cost more time and paper than the subject was worth to expose many of those palpable attempts to saddle the climate with the errors and mistakes of individuals, still to place one of those attempts on a proper footing, may be very useful; and it will naturally lead the farmer to investigate cause and effect more closely than it would seem has yet been done, before he admits that an alteration in the climate is the real cause of the changes in practice which have been attributed to it.

This is the more important, for if the change rests merely on an alteration in the seasons, it would appear, that every alteration in practice, made in consequence of an alteration in the climate, should be regulated by the previous knowledge of this alteration, and how long it would continue. Consequently, that no fixed general principles could be established, unless those very ingenious men, who make our large Dutch almanacs, could be prevailed upon to supply this deficiency, by a very long addition to this highly important calendar.* But to proceed. Judge Peters tells us, under date of the 10th of August, 1811, that "I was formerly of opinion, and *succeeded under it*, that thin sowing was, in clean and fertile ground, the best. But I am now convinced that, by some *shift* of *circum-*

* This brings to my recollection an occurrence that happened several years ago. There lived about three miles from my former residence a German farmer noted for doing every thing well, especially for saving his hay in untoward seasons. This induced me to call and ask him by what kind of observations he made himself so well acquainted with the weather. He told me that he generally bought three or four different Dutch almanacs; that when he wished to become well acquainted with the weather, he spread them out before him, and with much attention considered the report of each. These he commonly found very different; but by due attention to what was stated in them, and by also comparing the prospects of the weather with them, he seldom failed to get in his hay without wet. It required but little penetration to see that my neighbour was indebted to his own very superior judgment, and not as he appeared firmly to believe to his three or four Dutch almanacs. As I however thought that any hints of this sort might aggravate but could not convince him of his error, I took my leave without seeming to doubt the value of his almanacs.

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stances and *change of seasons*, our fields, in whatever state of either fertility or poverty, require more seed than we have heretofore been accustomed to sow. I shall increase my quantity hereafter, never having sown more than a bushel per acre. I will also make some particular comparative experiments, as to quantities, on different acres. Cold and unfavourable springs have, for several years past, retarded the early shooting of the plants, and in such case they do not stool as formerly."*

On the 15th of July, 1812, this gentleman tells us, that "in consequence of the opinion as to a quantity of seed I mentioned in a foregoing letter, I have tried various quantities on different acres. *All are good*; but I think the grain from one bushel and a half of seed, has the largest heads, and will yield the greatest number of bushels." "I was, in my youth, an advocate for three pecks per acre. I now think five, (or six at the utmost,) pecks sufficient."†

Here I proceed from Mr. Peters's own testimony to prove that when he came to the determination, (to wit, in 1811,) to try the experiment of sowing more seed, there had previously existed no alteration in the seasons "for many years past," more than had usually happened.

He tells us, under the date of the 15th of July, 1812, that "the Smyrna wheat is now ripe, and fit for the sickle. It is a promising crop, and has withstood the storms and *unfavourable season* far beyond any other grain. The harvest is later, *at least ten days*, than it has been for *many* years past."‡ Here is ample testimony "the harvest of 1812 was ten days later than it had been for many years," and yet we find the Smyrna wheat was "ripe and fit for the sickle" on the 15th of July. Now, if we deduct ten days from those fifteen it leaves five, and if from the five we deduct as many more days as we suppose ought to be done, in consequence of this gentleman's saying in the preceding year, that the Smyrna wheat "ripens somewhat late, and I almost dread the mildew, blight, or rust,"§ we shall find that the harvests, previously to 1812, were as early, "for many years past," as they had generally been since the memory of man, in the vicinity of Philadelphia. Why then complain of what could not, agreeably to his own statements, have existed "for many years" previously to 1812? The spring of that year certainly abounded in cold. The winds generally hung to the northward and north-east. As it happened to be the year on which I removed to this place, I very well remember that I left the farm on which I had been previously living, about the 23d of May, that the wheat, grasses, &c. were very backward, that I staid a day or two in Philadelphia; that during my stay there it snowed nearly all one day, and that enough fell to have covered the ground several inches deep, if it had not melted away nearly as fast as it fell, and that it continued cold throughout the whole of the month. It puts

* See vol. iii. Mem. Phil. Agr. Soc. p. 23, 24.
† Idem, page 27, 28.
‡ Idem, page 26.
§ Idem, vol. iii.

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me in mind of what happened about forty-five years ago. I was then living with my father-in-law, on his farm on the eastern shore of Maryland. It was so very uncommonly cold that we had to kindle fires, and sat by them after the wheat was in head.

In fact, it has ever been the case since my recollection, that when the winds generally hung to the northward and north-east until late in the spring, in our maritime country, the springs were always cold, and vegetation greatly retarded. On the west side of the Allegheny, warm winds commonly prevail in the spring, and in some of the valleys there, vegetation is in the same line of latitude, about three degrees forwarder than in the valleys on the eastern side of the mountain.

Volney, after labouring hard to substantiate this imaginary change in our climate, says, "Dr. Rush, indeed, seems to hesitate in his belief, after noticing the severity of several late winters, and thinks some errors may have arisen for want of thermometers." Now, this candid acknowledgement of Dr. R. who had previously written to substantiate the supposed change in our climate, does honour to his head and heart, and ought to have its full weight with those who wish to investigate the subject.

Mr. Volney, after this, observes, "I cannot, however, believe with Mr. Williams, that the colds have been much diminished in degree in the course of the last century. The cold of 1683 was, according to him, greater than that of 1782; was attended with similar circumstances, and was the greatest ever known; but this estimate is merely conjectural, and his reasonings cannot supply the want of thermometrical observations, at the former of these periods. Thermometers, indeed, were unknown in America until about the year 1740. This conjecture is the less plausible, if we admit, what I think I have proved, that the north-west wind is the great source of cold in North America, since the wind has undergone no alteration in its properties. The experiments of Dr. Ramsay afford analogies that will justify us in dissenting from this theory. This writer, on comparing the observations of Dr. Chalmers, made between 1750 and 1760, with his own, made from 1790 to 1794, found a difference of only half a degree in the heat; a difference so small that it may reasonably be ascribed to a difference in the instruments; but if the heat has not increased, we are obliged to infer that the cold has not diminished. What appears to be demonstrated on this head, is that winter is shorter, the summer longer, and the autumn later, than they formerly were, but that the cold, as the last ten years sufficiently evince, is as violent as ever.

"Mr. Mackenzie, who admits these changes, supposes the cause to be inherent in the globe itself, because he has witnessed them in places where the ground remains in its primitive state. But if these places, which he does not mention, be in Canada, they tend only to confirm my suspicion, since the removal of the forests in certain mountains and slopes of Genesee and Kentucky, would un-

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avoidably introduce streams of mild air into Upper and Lower Canada from the south-west."*

Now it would appear that Mr. Volney, in order to substantiate his theory, has first to suppose that the traveller, Mr. Mackenzie, was in Canada, when he made these observations; secondly, that the removal of the forests in certain mountains and slopes of Genesee and Kentucky, would unavoidably introduce considerable streams of mild air into Upper and Lower Canada from the south-west. It would, however, be a difficult job to determine where Mr. Mackenzie made these observations; but still vastly more difficult to suppose that the settlers, when Mr. Volney wrote, had abandoned the fertile plains of these two states, to clear and cultivate the rough and unfertile grounds on the mountains.

Enough, I trust, has been said to convince the plain practical farmer, that no alteration has happened in our climate which should induce him to alter any practice that time and observation has determined to be good.

There is, however, another cause, which only exists in the imagination of some cultivators, and to which some of them also attribute the changes made in their practice and opinions: to wit; the absurd idea that locality alone is sufficient to destroy the good properties of the best of seeds, and most highly improved breeds of animals. I could readily mention very pointed, as well as laughable cases, which would clearly determine that locality had nothing to do with the changes which some have attributed to it. But if I were to do this, it might look as if I took a delight in goading the feelings, and exposing the follies, of others.

The alteration, however, in the quantity of wheat to be sown to the acre, is a very important one, as will more clearly appear when I shall fully explain that subject: therefore, it ought to be noticed by me in a way that seemed the most likely to impress the subject on the minds of my readers. It is believed, however, that the President may yet discover that two bushels, sown as early as the depredations committed by the Hessian fly will admit it to be safely done, will be far better than one and a half. For though it is readily admitted that the heads of thinner sown wheat will be always larger than that which is thicker sown, be the quantity sown what it may, still, it should be recollected, that it is not the size of the heads which determines whether the quantity best calculated to yield the greatest product to the acre, has been sown. This can only be determined accurately by measuring the produce. It, therefore, seems to follow of course, that Mr. Peters will be far better prepared to determine the proper quantity of wheat that should be sown to the acre, after he has employed more years than one, in a practice which he acknowledges is new to him.

* See Volney's View, pages 216, 220, 221.

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CHAPTER XVIII.

Remarks on the economy of the potato. Also on growing it on thin set woodlands. Directions how to grow this plant, so as to obtain a succession of new potatoes throughout the winter. It will live and perfect its fruit on but little nutriment. Some varieties are vastly more productive than others. To obtain the best, the seed should be sown and cultivated. Observations on the mode of cutting the sets and cultivating the plant. Also on scooping out the eyes, planting, and cultivating them. The largest potatoes should be selected for seed. By planting small ones the best variety is degenerated. The crop is injured by misplacing the vines and leaves in the cultivation of it.

I WILL now describe the best mode of cultivating the potato; but before this be done, it may be useful to make some remarks on the economy of the plant. I cannot do this better than by transcribing what I published on that subject in Mr. Poulson's paper of the 16th of February, 1816, to wit:

MR. POULSON. Observing in the third volume of the Memoirs of the Philadelphia Agricultural Society, that the properties of the potato plant have been injuriously represented by Judge Peters, I have thought it useful, consequently proper, to vindicate the character and economy of that invaluable plant.

He says, "that it is an exhauster we have long known." Now, so far as my information extends, it is considered by the farmers in this country to be an ameliorating crop. To prove that it is such, I will first transcribe an extract from a communication made by me on the 4th of January, 1814, to the society over which he presides, on the cultivation of this plant. It so happened that this was not published in the Memoirs.

"The foliage of this plant is well calculated to gather much nutriment from the atmosphere. It also evinces a peculiar disposition to draw a large proportion of its support from moist confined air. It will grow and produce fruit when only covered with chaff or straw,* although little traces of the decomposition of either appear. This occurs in situations where light and air have been almost excluded."

"On the 5th of June, 1811, I handed you† some potatoes, grown in the arch supporting the bridge at the north side of my barn. They were equal in size to any I saw that day in the Jersey market of the same year's growth, and were considered good by my family. The arch had not been well constructed, and was rather damp for storing that root. It was filled in the fall, but having abundance

* It will do this when laid on the hard ground in a yard, if sufficiently covered with straw.

† Dr. James Mease.

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elsewhere, it was not opened until late; those causes combined produced this effect. If Mr. Young had made his experiments on grass grounds, or introduced other substances calculated to gather and confine moisture and air, it is probable he would have found the potato far less exhausting.

"Still they are a very luxuriant crop, and one or more grain crops generally follow before the grounds are laid down in grass. Of consequence, they should not be grown without manure, except on grounds where the timber has been recently removed or girdled, on which they are very profitable, and the best preparation for following crops.

"From attentively observing this plant, I believe it may be profitably grown on thin set woodlands; and I grubbed out the useless plants of a small portion of my woods to make the experiment, but my removal here put a stop to this and other projected improvements. The shovel plough used here among roots and girdled timber, will readily prepare the soil, and the fall of the leaves will answer for manure, if cropping be not carried too far. The cultivation will improve the young timber plants, and trimming the trees gradually, will economise fuel, and let in more sun and air.

"It appears reasonable to suppose, that a regular and plentiful supply of new potatoes may be readily obtained through the winter and spring by erecting frames one above another in a tight room or house, covering the floors of those frames sufficiently deep with half rotted chaff, in which plant the potato sets, after wetting and rolling them in gypsum, or mixing some leached ashes with the chaff. A few panes of glass to admit light is necessary, and the sashes should be opened in fine weather; a stove to kindle fire when severe frost is expected, should be introduced. Mr. Peale's smoke eater is cheap, and requires but little fuel, and is far better than iron for this purpose. The chaff should be occasionally watered, and the house distant from others, or fire and chaff under the same roof may become troublesome neighbours."*

A plant possessing these properties cannot be more exhausting than any other equally valuable, provided suitable materials are applied to gather a sufficiency of that food which it is evident the plant will live and thrive on, independently of any nutriment from the soil.

As Mr. Young's experiments to ascertain the properties of the potato were not formed on principles calculated to gather this kind of nutriment, they prove nothing but that he had not investigated the economy of the plant,† and that the poor in Britain have suffer-

* Boxes without bottoms, placed on the earthen floor of a light airy cellar, and filled with rich mould, would be a cheaper, and perhaps a better arrangement. The heat and moisture arising from the earth would invigorate the plants. There would be less danger from frost if the cellar was good, and the expense of the stove, as well as the risk from fire, would be avoided.

† That the economy of this plant has not been thoroughly understood, is evident from an essay to obtain new potatoes during the whole year having lately obtained a golden medal.

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ed greatly in consequence of this mistake. The owners of land there, being alarmed, have restricted the growth of this root, which nature seems to have calculated exactly to supply the wants of oppressed humanity.

It will not only produce valuable fruit on little comparative nutriment when properly managed, but the cultivation of it is so simple, that an indigent Irishman obtains considerable increase by laying the sets on a hard sward (without any manure,) and covering them with the earth dug from the ditches between the beds.

Leaves, twigs, cornstalks, straw, stubble, weeds, or any other offal vegetable matter, calculated to gather and confine air and moisture, will produce profitable crops of this root. But if plenty of this kind of food be not provided, the plant is compelled to prey upon the soil, just like an ox tied up in a stall to be fattened with grain. He becomes a powerful and expensive exhauster of corn, although he will fatten freely, and with but little comparative expense, on grass alone.

This subject might be illustrated in many ways; but as it happens that an indigent Irishman depends principally on potatoes for his support, I will briefly remark, that when one of these hardy and laborious sons of Erin emigrates to this country, where labour is high and provision cheap, he soon becomes a powerful exhauster of flesh and other expensive food. Yet we do not observe that his health or his strength is greater than when he lived principally on potatoes and buttermilk.

The President also says, that the potato "should be cultivated as a crop by itself, and not in connexion with a grain course." I have never grown better wheat than has followed potatoes, but the quantity of seed was increased as the season advanced. If others have suffered by this practice, it is more than I am aware of; but certain I am, that under the present mode of cultivation, no preparatory crop can be superior to potatoes, for growing spring wheat, barley, or oats; and these, followed by clover, furnish a luxuriant lay for wheat. Why then, in the name of common sense, should this root "be cultivated as a crop by itself, and not in connexion with a grain course?" Is the ground, like a Virginia tobacco patch, to be always used for the same purpose? Those who endeavour to overturn established practices should at least propose others.

Mr. Peters likewise observes, that "if dung, proper for a wheat crop only, is laid on for potatoes and wheat, little fertility will be left after the crops are gathered." This is granted; but he should have recollected that Mr. Young, whom he quotes to prove the exhausting properties of the potato, says "that one acre of potatoes, at a moderate calculation, is equal to two of wheat."

As this is true, it proves the farmer will save, by growing potatoes, the value of one crop of wheat, with the manure and labour necessary to grow it; also, one year's rent of the land, even if it should require double the quantity of dung to be applied to the po-

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tatoes when wheat is grown after them, for the cultivator gets the value of three crops of wheat in two years."

"But I am obliged again to differ from the respectable President. I never have observed the violent, outrageous, ungovernable, morbid, exhausting, mischievous, unrestrained, infuriated, and desultory effects"* of fresh manure of which he complains, nor do I ever, like him, rot my manure, to avoid the evils he enumerates, as flowing from fresh dung, such as the 'superabounding azote and poisonous qualities of muck'† &c. For, if fresh dung from the same number of cattle, that would furnish a sufficiency of manure, to be decomposed for the wheat crop alone, be applied to the potatoes, it will be found that after its 'infuriated rage, poison,' &c. have been spent in perfecting that crop, a sufficiency of nutriment will be left for the wheat and the grass, which are to follow it." "For the manure is not exhaled by the sun, scattered in the winds, or eaten by innumerable insects, which take wing and fly away with the carcasses, reared at the farmer's expense, unless they be killed by mixing septic substances with the manure, which is still more destructive than they."

Having observed the evils arising from covering potato sets with the sod in the usual way; also, that when the plough, roller, and harrow have pulverised the soil, for the growth of this plant, the hauling and spreading of the manure poaches the ground sadly, especially, if dripping weather occur; likewise, that if the horse hauling the manure go in one furrow, and the wheels of the cart in the furrows on each side of him, the intervals are little injured, but the bottoms of the furrows are hardened like a road; these considerations induced me in 1811, to pursue a different course.

Slaked lime was spread over a grass lay, and long fresh dung over the lime; the grounds were ploughed four times in the same direction; this being the best mode of ploughing to pulverise a sod; they were harrowed as often, and rolled twice or thrice. The long fresh manure made the two first ploughings troublesome; still, it and the grass roots were so completely incorporated with the soil, that it seemed light and mellow like an ash heap.

The head and foot of the patch were staked, at the distance of three feet, to regulate the width between the furrows formed for planting. A wheel barrow with small blocks of wood fastened on the wheel, made indentures in the bottom of the furrows for planting. Whole potatoes, of a marketable size, were planted at the distance of seventeen inches asunder. The plants were lightly earthed up twice, before the fruit roots were in danger of being cut off, and hand hoers followed to uncover and dress up the plants; after this, the weeds which outtopped the potato vines were cut off by the ground with a knife, as pulling them up uncovers the bulbs, and injures the crop.

* Mem. Phil. Agr. Soc. vol. iii. page 222. † Ibid, 231.

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The potatoes in each cluster were inconsiderable, when compared with the number of plants; this induced me to remove the ground between several of the clusters; in doing this, not one potato was seen in about half the space between them; from this it appeared, that eight or nine plants arising from the same number of prolific eyes in a whole potato, were by far too many to stand in one cluster. This was confirmed, for by calculating the number of prolific eyes in the seed, it appeared, that the crop had produced only about one potato for each eye planted.

If each potato had been cut into four pieces, and the sets planted at half the distance, the product would have been much greater, and half the seed saved; still under this marked mismanagement, and an injurious drought during the time of bulbing, the crop measured at the rate of three hundred and one bushels to the acre.

It has been said, that more than double this quantity has been grown on an acre of ground, and it seems probable. Of this, however, I can say nothing certain, either from practice or observation, as this is the largest crop that has been grown by me, or that I have known to be grown by any other person. However, I believe it would have produced at least half as much more, if the arrangement and cultivation of the plants had been equal to the preparation of the soil.

It would be difficult to devise a better preparation to grow an extensive crop of potatoes. But independently of the erroneous arrangement of the plants, it cannot be profitable. The cultivation was too laborious and expensive; the roots of the grasses, and farm yard manures, were not only exposed to useless waste from the sun, rain, &c. but also to the destructive effects of the lime intimately blended with them. The ridging up of the plants, though done with due precaution, was certainly very injurious; more especially, as the weather happened to be dry, while they were perfecting their fruit.

Yet, if the arrangement of the plants had been favourable, and the crop uncommonly large, as I believe it would, and also published, without comment, no question but many would have been led into error by it.

The reader will recollect, that the indigent Irishman obtains profitable crops of potatoes, without manure, by laying the sets on a hard sod, and covering them at a proper depth, with the earth digged from the ditches between the beds.

The size and number of potatoes, obtained in this way, clearly determine, that the powerfully expanding force of the fermentation of the grass roots, contained in the hard sod, is sufficient to open and divide the covering above, which is only to a very small extent composed of the same material, so that the fruit, roots, and bulbs formed on them are not oppressed; from which, and various other proofs and circumstances, arising from observation, as well as actual practice, it is evident, that luxuriant crops of potatoes, may be obtained from grass lays, with but little comparative labour

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and expense, by one plough following the other in the same furrow. After the farm yard manure has been spread over the lay, pare off the sod not more than three inches deep, turning it with the manure, to the bottom of the next furrow, which should be previously formed. On this inverted sod, plant the potato sets. The second plough should cover the sets about four inches deep, with the soil under the furrow, from which the first plough had pared off the sod. The whole depth of ploughing will, in this case, be seven inches. After ploughing as many furrows in the same way, as may be necessary to form the width of the intervals between the rows, another row of sets should be formed in the same way as the first, proceeding in this manner, until the field is planted. After which, if the soil be free and open, harrow the surface of it, with the tined harrow, until it be well pulverised, as deep as may certainly be done without disturbing the potato sets. If it be too adhesive to be well pulverised by this tool alone, it should be done by the hoe harrow, with the tined harrow following it.

If the soil be too retentive of moisture for this plant, or the small grain following it, the manner of ploughing, for putting in the potato sets, should be calculated to form the grounds into ridges of a proper width. From three feet to two feet nine inches, is certainly wide enough for the intervals between the rows. The latter distance would be preferred by me, except where stumps or other obstacles obtain.

Very large potatoes are not better for table use than those of a moderate size, and not so good when the increased size causes them to grow hollow in the heart. Large potatoes have large eyes, and these produce large vigorous stems and roots; consequently, the largest should be invariably selected for seed. Such as farmers commonly call seed potatoes should never be planted, but in cases of absolute necessity, and then only from the growth of large seed. They not only produce small debilitated stems and roots, but if selected for planting year after year, will soon degenerate the best variety. Still, farmers who really endeavour to improve their breed of horses and cattle, by employing the best studs and bulls, without considering the expense, (unless it be too extravagant,) yearly plant small potatoes, and some even go so far as to declare they are best. However, practice, reason, observation and the great affinity that there is between plants and animals, clearly determines they are wrong. If the largest and best formed potatoes, of any variety, be annually selected for seed, they may improve, but cannot degenerate; provided sufficient nutriment and good cultivation be also employed. Unless it should hereafter appear, that the duration of this plant is (as some say trees are,) limited when propagated by cuttings. If they should degenerate from this cause, it certainly does not happen for a long time.

The eyes of each variety, commonly grow very uniformly at, or about the same part or place, in every potato. Therefore, when the farmer has determined the number of eyes he wishes to have in

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each set or cutting, he should examine the structure of the potato attentively, and fix on a uniform method of cutting it into sets. He should suffer none of the cutters to deviate from it, unless they can point out a better. Much time is saved by this practice, and when the cutters are suffered to adopt any irregular plan, which inattention may suggest, the sets are commonly mangled and misshapen. Some varieties have many more eyes than others; consequently, if the roots be large enough, those having the most eyes will afford the most sets.

When the intervals are from three feet to two feet nine inches, the sets may be cut with two eyes in each of them, if the structure of the potato will admit this to be done. However, it commonly happens that in aiming to do this, some sets will have but one, and others three eyes, unless much of the seed be wasted, or the sets very awkwardly and tediously cut. But as the cuttings are mixed together, it is by no means likely, that many of those which have either one, or three eyes, will immediately follow sets of the same description: especially as by far the greater part may, with proper attention, be cut with two eyes in them.

The eyes in the potato which has been planted some time by me, are not conveniently situated for regular and expeditious cutting. Still, with three straight forward cuts, (requiring but little attention,) six such sets as have been just described are formed, and although some of them are larger than others, none are too small. But I select the largest potatoes for seed, before they are removed from the field.

In intervals of the width just mentioned, the sets should be planted nine inches apart, from centre to centre, in the rows. If small whole potatoes be planted, the crop should be very early thinned, by pulling up by the roots all but two of the plants growing from each potato. If this be not done, the numerous and debilitated plants, growing from each one of them, will greatly injure the crop.

Some potatoes have very many eyes, others, though large enough to be cut, are too small to form sets with only two eyes. In either case, the supernumerary plants should be pulled up by the roots.

When the intervals are eighteen inches, sets having two eyes, may be planted twelve inches apart, from centre to centre, in the rows. As this arrangement is the same as that so successfully practised by Mr. Watson, on thin pasture grounds, without manure, it is thought that the introduction of double the number of plants grown by him, will not be too many on a grass lay, well manured, especially as the Rev. E. Cartwright, (a distinguished cultivator,) publishes in the fifth volume of communications to the British Board of Agriculture, that potatoes grown in double rows, nine inches asunder, with intervals of eighteen inches, the sets cut with one eye in each, and planted nine inches apart in the rows, produce from sixteen to twenty tons to the acre; which may be estimated at about rom six to seven hundred bushels, to the acre. This is a very large

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product, but it should be recollected that there is a very great difference in the increase of the different varieties of this root. At least quite as much, (and as I believe more,) as the loss of half the crop, from not planting the most productive. This seems to be the principal reason why the potato produces, generally, much greater crops in England, than in this country. Much more attention has been given there to raise productive varieties from seed.* I have sought for a productive variety of potatoes, but not from seed: consequently, I have not obtained it. Still, I have clearly seen a difference of at least one half the product, in the different varieties noticed by me. Also, that some varieties will attain a profitable size, on soils so thin as not to be capable of producing other varieties, large enough for table use, although the latter, when as well manured as is commonly done by the thrifty farmer, obtain a large size. These are interesting distinctions in the economy of the potato, and require much more attention than has been given to them. With proper attention, it may perhaps be hereafter seen, that there are varieties of many other plants, which will thrive and produce good crops, on much less nutriment than other plants of the same species. Practice has determined, that some breeds of domesticated animals thrive and fatten more freely than others, and on less food. Also, that some breeds of horses and oxen will labour, and keep in good condition, on much less food than others. It is evident, that the analogy between plants and animals, is strikingly great. Also, that we derive too little agricultural information from this interesting fact.

But to return to Mr. Cartwright's experiment. The bad effects of double hedgerow planting, was much less injurious in consequence of the introduction of single plants by him. Still, when sets are cut with but one eye in each, a part of them must be too small to support the infant plant until nature has determined that it shall depend on the soil for the nutriment gathered by its roots. Cutting sets in this very tedious way requires more time than accords with the population and high price of labour in this country. By cutting the sets so small, the organization which forms the stem and roots, will, without very great attention, be often more or less deranged by cutting a part of it off, and the plant be debilitated from this cause, as well as from too little nutriment, for its infant support.

It should be observed, that though the planting with narrow intervals may be the best, I have no practical information on this subject, having never planted in that way. Stumps and superficial roots will not admit the practice here. My planting below was confined to wider intervals, and but too frequently with the injurious addition of double rows. But be the intervals wide or narrow, a level and very superficial cultivation of the plants should be practised.

*More care is generally taken in that country than here to prevent them from degenerating.

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In the wider intervals, the hoe harrow, with the tined harrow following it, and hand hoes following the latter, will be best. In the narrow intervals, the skim, with a rake attached to the hinder part of it, should be introduced. If stumps and superficial roots obtain, the shovel plough will be best, until a better tool is invented for this purpose.

After the fruit roots are in danger, the cultivation should be more especially shallow; barely deep enough to extirpate weeds: consequently the tines in the tined harrow should be regulated, or much mischief will be done by them. The hand hoes will also dip by far too deep, if they be not closely watched. Cultivation must cease when the tops of the plants, by leaning into the intervals, would be injured by it. However, when this happens, they generally shade the soil so much as to keep most of the weeds under. After this, such vigorous weeds as may happen to outtop the vines, should be cut off by the ground with a knife; pulling them up by the roots uncovers the bulbs and injures the crops. In cutting off the weeds, great care should be taken not to misplace the stems and leaves, or the crop will be much more injured than many cultivators seem to imagine; as it is presumed that they would not mangle this and other plants so sadly in the cultivation of them, if they believed it was highly injurious to them.

Having observed that the timber on a high dry ridge, where the soil was very thin, had been girdled some years, and that the land had not been cultivated, I inquired the cause, and was informed that a former occupant had intended to cultivate it, but finding that another part of the same poor ridge would not grow even tolerable potatoes as a first crop, he had abandoned the project and cleared where the land was much better.

As it, however, seemed to make the place look desolate, I had the underwood, grubs, &c. removed from about two acres of it, and the ground prepared for a mixed crop of maize and potatoes. When this was known, my neighbours said if tolerable crops of either of those plants were grown on this ground, the same might be done on the barren ridges of the Allegheny.

The corn was planted in rows half a perch asunder, and the potato sets in single rows between the rows of maize, nine inches apart, from centre to centre of the sets. The soil was generally covered with a low growing plant called tea berry, or mountain tea. The roots of this diminutive plant are large, and run through the soil to an incredible distance; especially under the trunks of fallen timber.

After the potato sets were planted, the furrows were filled up with the roots of this plant, and other vegetation found on the grounds. These should have been covered lightly with ground, to promote fermentation, but other business prevented it from being done, until the potato plants were cultivated, at which time they were from nine to twelve inches high.

As the corn rows were wide apart, and but one single row of po-

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tatoes planted between them, it was thought that two plants might be left standing in each cluster, which were eighteen inches apart in the rows: however, when the maize began to shoot its prop roots, tassels, and ears, the change in the colour of it clearly determined the error of by far too many plants, for so thin a soil, and nearly half of them were speedily cut off by the ground; but not in time to prevent extensive injury. However, where the crop was not preyed upon by the rackoons, which came in from a thick shaded wood adjoining to the patch, the product was much better than I expected when I first saw the ruinous error of more plants than the soil was capable of perfecting, unless the roots of the tea berry had been sufficiently covered with earth to promote the fermentation and decomposition of them. But numerous superficial roots from the girdled timber, joined with bad ploughing, had prevented this from being done.

The potatoes were good; equal in size to Dr. Dewees and Mr. Philips's crop of that root, grown on a better soil, manured with dung. The cultivation of this mixed crop was level, and the result determines that rich and expensive manure is not necessary to grow valuable crops of potatoes.

When the maize and potatoes were removed, the ground was ploughed up into high, sharp, one bout ridges. It remained in this state until spring, when the ridges were leveled as soon as frost would permit, by the tined harrow, and spring wheat immediately sown and covered by the same tool. Timothy seed was sown immediately after the wheat. This was done to determine how that grass would prosper in a dripping climate, on a high, dry, and poor ridge, which had not been exhausted by cropping.

The wheat crop was productive, but would have yielded more if the seedsman had sown two bushels to the acre. But not being accustomed to sow more than one, it was seen, by the quantity remaining unsown, that he had employed only about one bushel and a half to the acre. The timothy was mowed this year, and the crop was light. The aftergrowth, however, seems to denote that the crop of the ensuing year will be much better, as it has generally a healthy and vigorous appearance. This change for the better, may have happened from the more extensive decay of the roots of the mountain tea, and other hard vegetation. The former when the potatoes were removed, were hoed up from the furrows in matted flakes, several feet long, with but little appearance of change. However, as the cultivator should in the general course of his business, have profit and improvement in view, I would advise him to sow red clover on such soils, if that seed can be had. Still there can be but little doubt that after the first crop of grasses grown on this patch has been three years annually mowed, and the second crops suffered to decay on the grounds, the soil will be ameliorated, and better calculated to grow the same, or any other round of cultivated crops, and the grasses which should follow them.

It may be laid down as a maxim in farming, that unless the soil

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be steril, or bordering on it, the ultimate improvement, or exhausting of it, depends more on how it be managed, than whether it be rich or poor, when the management commences; too many farmers, however, think otherwise. They have long been moving from one place to another, still further back, in quest of a soil, which will bear perpetual ploughing and cropping, and never wear out. When the Pacific Ocean puts a stop to their progress, it is possible they will be convinced, that no such soil exists, unless it so happens, that flattering prospects are held out to them from the other side of it.

Some cultivators have grown good crops of potatoes, by scooping out the eyes, and planting them, but others have tried this practice without success.

The practice is not a good one, as it does not provide sufficient nutriment of the best kind, for the infant plant; however, where provision is scarce, it should be employed, as much food may be saved, when it is most wanted. The crop may be so managed, as to be profitable, provided the eyes be scooped out so carefully, that the organization of them, to its full depth and width, be generally preserved.

To effect this purpose, spread the manure over the grass lay, after this is done, turn it by the plough, not more than seven inches deep; consolidate the furrow slices with the rollers; then pulverise the soil well by the hoe harrow, with the tined harrow following it, at least three inches deep. Form the furrows for planting, so that the sets will be four inches below the surface, after the furrows have been filled up, and the soil settled by rain, &c. In the furrows thus formed, sprinkle a little rich fresh dung, barely sufficient to promote the early growth of the plants. On this, place the sets, and cover them not more than two inches deep with the loose pulverised soil; taking care that no clods or stones be introduced with it. When the plants have attained a sufficient height, fill up the furrows, by the first cultivation of them; this will require but little extra labour, as the cultivation by the hoe and tined harrows may be readily ordered, so as generally to effect this purpose.

The failure in planting sets of this description, has proceeded from covering them too deep at first; or from doing this with long dung, filled with litter, or clods, and other substances, which the stems of the plants, growing from sets affording so little nutriment, could not penetrate; or, from not providing in the bottom of the furrows, rich manure, to supply as well as it might be done, the deficiency of nutriment in the sets.

Here again, we see the great analogy between plants and animals. Also, that an intimate acquaintance with this interesting subject, would naturally lead us to great improvement in agriculture. The animal, while in its infant state, must have food provided for it, as similar to that furnished by its dam, as may be readily procured, or it does not thrive.

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CHAPTER XIX.

On hand hoeing; also drilling turnips. The seed is generally sown too late. On sowing it, so as greatly to lessen the risk of injury from the fly. Observations on the ruta baga, or Swedish turnip.

Turnips are valuable for culinary purposes, also for feeding cattle. The crop is seldom hoed or otherwise cultivated in this country; therefore they cost the farmer but little labour. However, pulling, topping, and securing them is tedious, especially as the weather is commonly frosty and cold when this is done. Therefore, if there be a variety which will withstand the severity of our winters, it should be introduced. As the plant grows much faster in this country than it does in England, it is not in the same danger of being overrun by weeds; but as British farmers have greatly improved the seed of this plant, and spare no labour in the cultivation of it, the root grows vastly larger there, and is much more productive. If the same were done here, the farmer would be amply remunerated for the increased attention and labour bestowed on the crop. As the seed is frequently sown in this country on ground recently cleared from its wood, in such cases the labour of keeping the crop free from weeds would be but little.

Some of our cultivators can sow the seed sufficiently regularly to favour the uniform growth of the plants. Still this is seldom done, and when it has been accomplished, weeds too often take possession of the vacant ground between the plants, before they attain a sufficient size to smother them. If this does not happen, the fly, or other causes, too often frustrate the design, by the destruction of the plants. In this case, not only the labour and rent of the soil are lost, but the cultivator's live stock also suffers, unless he may happen to have a surplus of other food to make up the deficiency.

The injury done by the fly may be often avoided. If the seed be sown broad cast, sow at least two pounds to the acre; harrow this in well, but not with tines calculated to bury any of it more than three inches deep.* If it be sown by the drill-form, the furrows scarcely three inches deep, a rake, with tines properly constructed, should be attached to the hinder part of the drill, to fill up the furrows. After this, remove the coulters from the drill, and sow a sufficiency of seed on the surface, and brush it very lightly in. The seed, superficially covered, either by the brush, harrow, or drill, will generally come up first.

* It is doubtful, if the seed be buried deeper, whether it would vegetate and come up.

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If the plants be cut off by the fly, those from the seed buried deepest may escape. If moisture below, and a dry surface, cause the seed which are buried the deepest to come up first, the effect may still be the same. It will cost but little labour to remove the supernumerary plants, if the seed generally succeeds.

If the plants be sown broad cast, even one hand hoeing will very much increase the product. It will not be very costly if the farmer aids the business with his personal attention; by which, it is presumed, the hoers will be much encouraged, and instructed in a business which they neither understand nor seem to wish to learn in this country.

The supernumerary plants should be early removed. When they are suffered to stand in clusters until the root spindles upward, the crop is greatly injured. The buds quickly form, and rapidly increase in size, when the plants are early thinned. In this case, neither the leaves nor root are incommoded. The former spreads out luxuriantly near to the ground; and the latter takes on its proper form in and near the surface of the soil.

Since my residence in Philipsburg, I shovel-ploughed a small field which had been cleared some years before, but not cultivated; of consequence, overrun with weeds and matted patches of grass. It was also so filled with stumps and superficial roots, that the introduction of the long plough to turn this vegetation under the soil seemed to be impracticable.

After hoeing round the stumps, and harrowing the rough surface as well as I could get it done, turnip seed was sown. This was done by an old experienced farmer. He remarked, that the grounds were too rough, and the seed too early sown, to obtain a tolerable crop.

I, however, prevailed on him to sow the seed much thicker than usual, after it was harrowed in, the matted sods of grasses and weeds were turned by the hand, with the roots uppermost. When the plants attained a proper size, they were thinned, and the grasses and weeds eradicated by the hand hoe; but neither was done as well as I wished. It was found in this case as in most others, difficult to get American labourers to execute a business with care and attention, which they are not convinced ought to be done.

Still the crop was luxuriant, and the turnips larger than any I had ever seen before. The seed was sown on the 8th of July. This was considered quite too soon by the neighbouring farmers. It was confidently asserted by them, that the turnips would be small, stringy, and worthless. I had, however, observed that their turnips were small, and crops unproductive, in consequence of being too late sown.

The 8th of July may be too soon to sow the turnip in the vicinity of Philadelphia. Still, if it were possible to persuade farmers that frost does not make this (or indeed any other) plant grow, they would sow that seed earlier than they now do, even there.

In Great Britain, the turnips reserved for spring feeding are sown later than the crop grown for winter consumption. That practice,

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however, could do but little good here, where this root is destroyed by the frequent thaws and very severe frosts of our winters. The same has also happened to the ruta baga or Swedish turnips which I have seen grown in this country. This may, however, occur by procuring the seed from England, where the farina fecundans from the blossom of the common turnip creates a variety which is much less hardy than the original plant, but still hardy enough to withstand the winters of England, where the common turnip frequently escapes any serious injury from frost.

Gentlemen who are fond of improvement, and who wish to introduce a valuable addition to our agricultural resources, should import the seed of this plant from Sweden, and from that part of it where it is least likely to be contaminated, from an accidental mixture with a less hardy variety. Also, if possible, from a good cultivator, who has improved his seed by selection, good cultivation, and a plentiful supply of nutriment for growing the crop. Certainly the valuable properties of plants, and of their fruit, are increased in the stamina and organization of the seed, the same as that of animals; and the same judicious selection, as it respects size, form, and valuable properties, is equally necessary; as is also an abundance of nutriment, joined with good cultivation.

We would not readily believe that the breed of cattle was to be improved by feeding them on straw through the winter, and turning them out through the spring, summer, and fall, to obtain a scanty supply of grass, from road and lane sides, or commons fed bare, where runtling bulls, which are, in common, plenty in such places, would be the sire of the calves reared from them.

A change in locality, to where better management and a plenty of nutriment prevailed, would in time greatly improve even this degenerate breed. If, however, they were removed from one neighbourhood or state to another, as long as the world lasted, and no better food and management prevailed, they could never improve. Time would gradually degenerate them into a very small, hardy race, capable of existing where a better breed of cattle would be starved to death, or destroyed by the diseases which are the offspring or companions of poverty. Nearly the same happens to seeds strewed over a poor soil. Some varieties perish altogether, others that are more hardy remain torpid until the grounds are enriched. There are, however, many which vegetate and grow; but these, unless their nature and properties are congenial with a poor soil, never fail to degenerate in their stamina and organization, until they become accommodated to the soil. In the latter case, the fruit obtained from them is small, and the quantity inconsiderable. The same weight or measure of it is nothing like so rich and nutritive as that obtained from improved seed of the same description sown on grounds well cultivated, and containing sufficient nutriment for the plants.

Drilling turnips, in rows from eighteen to twenty-seven inches asunder, and thinning the plants, so that they will stand from nine

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to twelve inches apart, from centre to centre of them, and keeping them free from weeds, with the skim, will produce much larger crops, than are obtained by sowing the seed broad cast, and hand hoeing the grounds, or by drilling the seed and ridging up the plants. Ridging cuts off and laps over the lateral roots, which run extensively through an open and free soil. It likewise confines them in heaped up ridges, also forces them to take unnatural directions, and compels the plants to form a multitude of very injurious roots from the sides of their bulbs.* The soil will likewise be far better prepared, and with much less labour, than by either ridging or the hand hoe, for small grain, and the grasses following it.

If a grass lay be selected for the turnip crop, and sufficiently manured, also prepared in the way which has been before described, the product will be luxuriant. However, it should be observed, that if stumps and superficial roots obtain, the distance between the rows of plants, should be at least thirty inches.

Since the foregoing remarks were written, my neighbour, Mr. Hardman Philips, has been in England. He brought back with him the seed of the ruta baga, procured from a distinguished British cultivator, who assured him it had been carefully grown, and not mixed with other varieties.

Mr. Philips drilled this seed, by a very simple drill, made with but little labour and expense, on ground abounding with stumps, and superficial roots, but very rich. The crop is the most luxuriant, I have ever seen of turnips of any variety. It however so happened, that the plants on about three-fourths of the land were cut off by the fly. This part of the ground was resown, and the plants growing on it were very luxuriant; but the fall must be favourable if they attain full perfection.

Mr. P. has determined not to pull them up in the fall. If they should remain unhurt through the winter, they will be a very valuable addition to the agricultural resources of this settlement.

July, 1818. The winter has passed by, it was uncommonly severe, often excessively cold, and then again warm enough to thaw the surface of the ground. To avoid the risk of a total loss, Mr. P. had a part of his ruta baga pulled and secured in the fall. About two-thirds of those left standing where they grew, were more or less injured by frost; some of which were entirely rotten. Yet it may be that if the sound and hardiest looking bulbs, which had braved the winter's frost were annually selected, and planted out for seed, a variety might be obtained which would stand the severity of American winters. For it is said that bees carry the farina fecundans to considerable distances, and by this means, unthought of mixtures are produced.

* A considerable part of the turnip naturally grows above the ground, when this is covered with soil, the plant is compelled to exhaust its energies in growing from the covered surface of the bulb, a multitude of useless and injurious roots.

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It would seem, however, that the barley following Mr. P.'s ruta baga, is so inferior to that which last year followed after his corn, that he will take but little if any care to improve the seed. Still I believe the seed ought to be improved, for the plant is vastly more nutritive than the common turnip. It is also in my estimation, more agreeable for table use. Some of the roots grown by Mr. P. weighed eight pounds, after their tops and tails were cut off. If the plants from the first sowing had stood, it would have been the heaviest crop of turnips by far that I have ever seen grown. The leaves of this plant are very sensibly affected by heat; they will droop, early in the fall, when the sun shines but moderately warm.

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CHAPTER XX.

On the carrot, parsnip, and beet. Also, on mangling the beet, the grape vine and other plants. On sowing maize, broad cast, for soiling.

No question but the carrot, beet, and parsnip, are very nutritive food for domesticated animals. However, as I know nothing practically of those roots, but in my garden, little will be said of them; except on the injurious practice of pulling the leaves of the beet, while the plant is perfecting its root.

So far as my experiments and observation extended, it was clearly seen, that nature had made the tops of plants equally as necessary to the health and vigour of them as are their roots. I have ever observed that mutilating the former, never fails to injure the general economy of the plant; therefore I am compelled to believe that when vegetation is better understood, it will be clearly seen, that very serious loss occurs from pulling off the leaves of the beet, before its root is perfected, in place of the very great gain which some gentlemen confidently assert, arises from this irrational practice.

If independently of this loss, the gentlemen who boast of the great value of the leaves of the beet, were to calculate the expense of pulling and gathering them, I am indeed greatly mistaken if they would not find that the milk and butter, obtained by this very tedious and expensive practice, will cost (at least in this country,) much more than they would sell for, after adding the necessary expenses of the dairy, marketing, &c.; without taking into consideration that when grass is plenty, (which commonly happens when the leaves are used,) the labour is entirely lost.

I have before observed, that a very great loss occurs in potatoes, if the tops be cut for feeding cattle when the plants are perfecting their roots: yet it has been asserted, with equal confidence, as of the beet, that this does not happen.

Mr. Bordley also says, "The husbandmen in America would do well to try the method of cultivating maize practised in Italy, France and Spain, where it is sown very thick, broad cast, for producing fodder, and for stall feeding, or soiling; and when for a crop of corn, is planted in squares of two feet, and even the blades are daily pulled and given to the cattle."*

In this country, labour seems too scarce and high to employ the plough for the express purpose of growing green crops of this description, for feeding cattle. I am also disposed to believe, that in any

* See his book on Husb. page 463.

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country where a good system of husbandry is pursued, proper grasses, even for soiling, will be found by far the most economical practice, and, of consequence, much the best.

If, however, it should be found otherwise, it is probable that no plant can be more profitably employed for this purpose than maize. I have tried the Guinea corn for soiling. It suckered greatly after the first cutting. If it be early sown, in a rich soil, it may be cut three times, if the climate be favourable.

I believe, though I have never tried the experiment, that the same would happen, if the corns common to the country were sown for this purpose: provided the first cutting commenced before the prop roots and ear shoots appear. It should, also, be cut the second time before this happened, more especially if a third cutting was expected.* The little yellow, or white, is best for this use, as they sucker much more than the larger corns; particularly the gourd-seed.

Whoever will make himself acquainted with the economy of maize, will see that scarcely any practice can be more destructive than stripping off the blades from this plant prematurely, when it is grown for "a crop of corn." Yet Mr. Bordley's book on Agriculture is a very valuable work; for, saying the least that can be said of it, it contains more valuable information on this subject than any other which I have seen that has been written in this country. However, I have not seen the agricultural essays entitled Arator, said to be written by a citizen of Virginia. Judge Peters says, "he is an able advocate for the use of long and hot muck." So far, this writer is certainly correct, if the President means, (as I believe he does,) fresh dung well stored with litter. But to return to the mutilation of plants.

Although the practice of mangling and otherwise mutilating plants, of almost every description, has been advocated and highly recommended, by gentlemen of distinguished talents and extensive agricultural information; yet this is no proof that the practice is not injurious, and also irrational.

For notwithstanding we are indebted to some of these gentlemen for very valuable improvements in agriculture, still, it is clear that a laudable desire to improve, has induced too many of them to introduce practices immediately opposed to nature; and to pay too little respect to obvious causes and effects. These ought always to govern the practice of every cultivator, at least so far as to prevent him from admitting any opinion or practice opposed to nature, reason, common sense, and observation.

It is, however, evident that in some cases it is rational, and, of consequence, best to admit a less evil to prevent a greater. Thus lucerne should be cut off when overrun by the insects which some-

* I have often noticed in fields that if the plant be broken off by the ground, while it is young, it quickly grows again from the stub, and that this does not happen after the ear shoots appear.

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times infest this crop while it is young. This, by destroying these intruders, puts a speedy end to the depredations committed by them, and the grass grown afterwards is very valuable, notwithstanding it may be less productive than it would have been if the plants had escaped injury.

Maize, in climates where it is subject to be destroyed by early frost in the fall, when it is planted at the usual time, ought to be put much earlier into the ground, as it suffers vastly less by being cut off in the spring.

If the trees in a nursery be mangled by cattle, or in any other way, the wounded parts should be removed, as they will sooner regain what they have lost by this manifest injury.

If the peach tree be cut off close to the ground while it is young, numerous branches spring from the stump. We are told that this alteration in the usual form given to the plant, alters the economy of it so much that it will live and produce fruit for many years.

Now, if this be a fact, it would seem that the practice should be pursued by those who know it will answer, until they become acquainted with a better mode of management; notwithstanding it will procrastinate the gathering of fruit from the tree, and seem to compel planting the stone, in place of improved scions, or grafts.

There exists, however, no reason why plants should be generally barbarously mutilated, or that the general economy of them should be so much altered, as is sometimes done in our vineyards and orchards.

After examining Mr. Joseph Cooper's grape vine, and the incredible quantity of fruit hanging so closely together on it, it would be very difficult to persuade me that he could have obtained any thing like the same quantity of grapes from the ground overspread by this extensive plant, if it had been as thickly set with as many vines as could have been grown and cultivated on it in the usual way of cutting down and trimming the plants.

In fact, it seems irrational to believe that nature would have formed the branches of this plant so very extensive, for any other purpose than that of rendering it more productive. This seems clearly demonstrated by the product of Mr. Cooper's vine: yet the wisdom of man has been such that it has discovered, through the medium of inconsiderate theories, that nature has been greatly mistaken in the formation of this plant. They, of consequence, have greatly altered it by art, and much for the better, if it were possible for reason, common sense, and observation, to believe the volumes which have been written on this subject.

It is, however, evident that this extensive mutilation of the plant must cause a very different circulation of the sap from that which takes place when it is suffered to retain its native form.

Notwithstanding reducing the natural spread of its branches will diminish the extent and vigour of its roots, still they will be too extensive for the size of their circumscribed tops. The small slope

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left for the sap to circulate in, above the soil, seems in itself sufficient to cause the rupture of many of the more tender vessels, and produce mildew, disease, and even death; especially in this country, where the natural course of vegetation is very rapid.

That the rapidity of the circulation of the sap is greatly increased by the diminution of the top of plants, is clearly seen by the exceedingly quick growth of the sprouts, which spring from the stumps of such a variety of trees as put out suckers after they have been cut down.

I have been informed that some cultivators, in order to obtain a still more rapid growth of the most thrifty and best looking suckers, which sprung up around stumps, have destroyed the whole by the too speedy removal of a part. The reason assigned for this unexpected destruction was too rapid a flow of the sap.

However, as it is said domesticated animals do not relish the top of the parsnip, it does not seem to be concerned in what has been said on mutilating the top of the beet before its roots are perfected.

But, as I am told, this plant prospers best when the seed is sown in the fall, it is considered proper to apprise the reader of this: also, to advise him to sow about the time when nature scatters the seed from the plant: especially as I have seen much larger roots grown in my garden, by what is called volunteer plants, than I have ever observed from seed sown in the spring, on beds well manured and prepared for this purpose.

The parsnip does not appear to be injured by frost in the winter, but the cultivator ought to remove it from the ground very early in the spring, and put the roots where they will not vegetate. It seems to be well attested that this root has been known to acquire a deadly poisonous property after it commences shooting the stems on which the seed is formed.

This appears to be confirmed by the poisonous property of the leaves. I have seen the legs and arms of some who worked among the plants, while they were wet with dew, blistered, and considerably inflamed, while others working among them escaped unhurt.

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CHAPTER XXI.

On the arrangement, and superficial cultivation of a crop of maize. In what cases, lime may be profitably used for this crop; also, how it should be managed, and applied. The benefit arising from rolling the seed in gypsum; also, from covering them with a compost formed with light loose soil and dung. How seed is to be gathered and preserved. On the management to be pursued, when heavy rain, &c. forms a hard crust, which the plants cannot penetrate. When, and how, the grain and fodder of this crop should be gathered and cured.

To explain the proper cultivation of maize, and illustrate the great value of superficial cultivation, and also show that a large crop of corn may be grown with but little comparative nutriment, when the manure and roots of the grasses remain at the bottom undisturbed by useless, expensive, and very injurious labour, I will describe the cultivation of one acre of ground.

This was measured off near the cabin on my farm, that it might be the better defended from birds, and for the express purpose of growing a very large crop of corn; for, although I had not either professed or believed, that I understood the proper arrangement of that plant, yet I recollected I had never been disappointed in obtaining large and well filled ears, when only thirty-three plants were suffered to stand in the length of one perch in the rows: provided, the intervals were wide enough to admit sufficient scope for sun and air, and the soil was only tolerable, and properly manured.

My mixed crop of maize and beans, planted the preceding spring, which will be hereafter described, induced me also to believe, if no other plant but corn were introduced, that intervals of five and a half feet, with clusters eighteen inches apart on the rows, suffering only three plants to grow in each cluster, would admit a sufficiency of sun and air; and this arrangement was adopted.

The soil on which this crop grew, was naturally thin, and had been exhausted by perpetual ploughing and cropping for several years, without any attention to grass, or manure; except, that nearly one half of it had been manured, in 1813, by a former occupant, for corn and potatoes, which were followed by rye. The dung had introduced on this part of the ground, a tolerable stubble crop of red clover; the remainder of the patch was covered by white clover, with some other native grasses thinly scattered among it; but the whole had been fed very bare in the fall.

I had intended to manure the ground highly, but untoward circumstances prevented that portion of the manure, which lay at some distance from the farm, from being hauled.

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The thinnest part of the patch was first manured; on that the quantity and quality appeared, generally, to justify the expectation of a large crop of corn; however it afterwards appeared, that so thin a soil required much more manure to do this. On the remaining, and better ground, the covering of manure was much thinner than I had been accustomed to apply, either for Indian corn or potatoes.

I had intended to spread thirty bushels of lime over the acre, after the manure had been turned under the sod. When the lime arrived it was nearly as wet as mortar; consequently could not be incorporated with the surface of the soil, so as to expect any material benefit from it, and it was not applied.

It was intended to turn the lay six inches deep, but numerous superficial roots proceeding from many large stumps, prevented a regular depth of ploughing; therefore it was not ploughed more than four inches deep in many parts of the patch.

However, staking out the ground, at the head and foot of the field, preserved a tolerable regularity in the furrows formed for planting; which were not less than three inches deep.* When a stump intervened, the furrows were formed round it, with the hand hoe: this preserved the full number of plants, or rather more. A wheelbarrow, with indenting blocks fastened on the wheel, made marks for planting, at proper distances in the furrows.

From ten to twelve grains were dropped in each cluster, and the whole length of the furrow filled up as high as the covering of the seed, which should not be more than one inch deep; when the clusters only are covered, the vacancy left between them causes the seed to be often washed out of the ground by heavy rains; especially if a descent in the field favour the injury. The continued covering, particularly if it be tapped by the hoe, retards evaporation, and promotes the germination of the seed.

When the plants were generally from three to four inches high, the surface of the soil in the intervals was scraped with the shovel plough; this should never be done deeper than is absolutely necessary to eradicate weeds; this instrument was followed by a light common harrow, with handles and blunt tines† to level the soil, overturn and mangle such weeds, as had been cut off, but not effectually destroyed by the shovel plough; hand hoers followed the harrow, to cut off the weeds and grass, but very superficially, from between the clusters: and also pull up such as could not be removed by the hoe, without wounding the plants.

The first cultivation leveled the furrows, which were not filled when the seed was planted; after the seed at the root was generally decayed, the plants were thinned. The suckers were removed, as often as they appeared in sufficient size to admit the operation;

* This depth seems necessary, as it prevents, to a certain extent, the plants falling down before the prop roots are established.

† Blunt tines do not dip so deep, therefore are not so likely to injure the roots of the plants.

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none, however, were pulled off higher than from the joint in contact with the ground, for reasons which have been explained.

The succeeding cultivations were executed in the same manner as the first, except the last, which took place, some time after the shooting, and in part filling of the ears.

As my ploughman was both careless and obstinate, and the hand hoers too long accustomed to dip deep, I dreaded both these operations in this stage of the crop, although either may be performed with the utmost safety, when carefully done; the weeds, however, happened not to be firmly established, and the hand hoers alone, by stooping a little more than usual, and lightly rubbing the edge of their hoes, from and to them, over the surface of the soil, completely eradicated the weeds; and with much greater expedition than if it had been done by the hand hoe in the usual way.

So much depends on the depth of ploughing, weather, and condition of the soil; also, on whether the first cultivation be, or be not effectually executed, that it is impossible to say how often a crop of maize should be cultivated; it is, however, sufficient to observe, it should be done as often as it is found that weeds and grass are likely to injure the crop. They do this whenever they appear in sufficient size and number to rob the plants of any material portion of the nutriment contained in the soil, therefore should be eradicated as often as they become thus injurious, more especially, as this will far better prepare the soil for following crops; and the superficial cultivation is not only safe, but also done with but little comparative labour.

The same is equally applicable to any fallow crop, when a superficial cultivation is practised. But maize (unless it be closely planted) admits of longer, and more perfect cultivation than any other plant grown by us.

The little patch now under consideration, lay immediately on the state road. The large size and number of ears, (though more than one on a plant seldom occurred,) caught the attention of travellers in general: many of whom stopped, and examined the crop throughout. But so great a novelty is even a tolerable crop of corn, (not only here, but in every place where I have been,) that these men appeared to be so much bewildered by the number of large ears, hanging in every direction through the field, that not one of them seemed to observe, that many of the stalks, where the manure had not been sufficient, either had no ears at all, or produced only nubbins of but little worth.

This was more especially the case round the stumps, which, together with the large superficial roots proceeding from them, occupied so much of the soil, that by far too little was left for the roots of the maize: especially as no more dung had been spread there, than on the rest of the ground.

It has, however, turned out much better than I expected, for I had feared the greater part of the patch would have been much more unproductive, in consequence of the great disproportion between

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the number of plants, and the food provided for them; so it would have happened, had not the deficiency in manure, been compensated for by a cultivation calculated to preserve the roots of the plants from injury, and to keep the manure at the bottom, where the fermentation and decomposition of it and the roots of the grasses, kept the soil open and mellow; and also applied the nutriment which arises from these important processes of nature, to the utmost advantage, and with the least possible waste.

The result has been flattering. The ears were pulled off from one row of corn, running through the middle of the patch, which was twenty perches long and eight wide. These were measured, and by multiplying the number of rows by the product of the row measured, the quantity grown on the acre was estimated at one hundred and fifteen and a half bushels of shelled corn.*

There can be little doubt, but a good grass lay well manured, and free from stumps and superficial roots, if it be arranged and cultivated as above described, will yield one bushel of shelled corn for every square perch, making full allowance for shrinking in the crib.

The ground is now in winter wheat, sown without any previous cultivation, covered shallow by the shovel plough; and the plants are healthy and vigorous.†

The water furrowing for the wheat, clearly showed, by the dark coloured stratum of animal and vegetable matter, still lying secure under the furrow slices, formed by ploughing for the corn, that a soil cultivated in this way, will be richer after it has produced a crop of maize and wheat, than it would be after growing the maize alone, under the usual mode of cultivation.

In case of a thin soil and light manuring, the corn crop, as well as the crop of small grain and grasses following the latter, will be greatly augmented if thirty bushels of lime, measured in the stone or shell, be spread to the acre, after the tined harrow has pulverised the surface of the inverted sod, and closed the seams between the furrow slices.

In this case, if obstacles will admit, the lay should be ploughed seven inches deep. The lime very intimately incorporated with the surfaee of the soil, either by a light harrow, or the common harrow well brushed. If this is not done, the particles of lime lying in contact with each other, unite and form a limestone gravel, which will be of little value, when compared with that of the minute particles of slaked lime, intimately blended with the soil.

* When corn is measured to estimate the product of a crop, it is commonly done when the ears are husked, or very soon afterward; consequently, it is to be expected that it will shrink very considerably after this in the crib; especially in high latitudes, where it hardens slowly, and generally carries into the crib with it much more moisture than where the climate is dry. However, this was certainly the greatest crop of corn that has been grown by me any where, or in any way.

† The wheat crop was a good one. The grasses following it have been mowed once, and were very productive.

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A very superficial cultivation of this or any other plant (except such roots as are gathered by ploughing or hoeing them up,) is exactly calculated to keep the lime long on the surface. It also secures the farm yard manure, and the roots and tops of the grasses turned under with it, greatly, from the injurious action of the lime; while the former is promoting vegetation under the lay, the latter is effecting the same purpose near the surface.

The lime should be slaked, and kept in a dry place until it is spread, either from carts, waggons or sleds. When it is put out into heaps over the field, it commonly slakes badly. If considerable rain falls, it is reduced to mortar, and cannot be either spread over, or blended with the soil, to tolerable advantage. In common, too much is left where the heaps stood. When this does not occur, nothing valuable will grow on the spots where the heaps lay, if they hapen to be suffered to remain unspread too long.

It may not be useless to remind the cultivator again, that as lime is a stimulating manure, nothing further than present emolument is to be expected from it, unless the soil be properly managed after it has been applied. Lime never should be applied, unless the grounds are laid down in grass, when the small grain which follows the fallow crop is sown, provided no other manure than the tops and roots of the grasses have been applied for the corn or other fallow crops. Or even when the additional assistance from farm yard manure, has been small. If, however, a judicious practice be pursued, the cultivator will find, that although lime is a powerful exhauster, when improperly used, it will greatly hasten the improvement of of his soil. It will increase the number, as well as the size, of the tops and roots of the grasses which follow the cultivated crops. This, if care be taken not to turn them up soon, for the commencement of another round of crops (unless dung be plenty,) will enrich the soil.

Maize, when planted on a grass lay, does not progress fast in its growth, until a partial decomposition of the roots of the grasses has made a free passage for the roots of the plants; and also provided sufficient nutriment for them; nor even when dung has been spread over the lay until the roots of the plants find their way into it. It will, therefore, be found an excellent practice to coat the seed plentifully with gypsum, previously to planting it. This will cause the plants to grow with much greater rapidity, until they can procure sufficient assistance from the dung. This early growth, like that of young animals, forms a far more perfect and robust organization of the plants, which will increase the product, and greatly facilitate the early ripening of the grain. The latter is more especially important in cold or backward climates.

Where dung and labour are plenty, it will be found still more advantageous to cover the seed with a compost formed of dung and light, loose soil; provided a sufficiency of the former be used to promote a rapid growth of the plant. Care should, however, be taken, not to introduce so much dung as would prove injurious to vegetation: also, not to use such as has litter incorporated with it,

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for this will certainly, more or less, oppose the coming up of the plants.

When the plants are not covered with compost, this should be done by the richest, loosest, and moistest soil, within the reach of the hand hoers. Within the compass of this very limited distance, the difference between the value of this mould, which may be readily obtained for this important purpose, is often very great.

If the compost be carried through the fields in light carts, and the wheels are not too high, and shovels used for covering the seed, the labour will not be much increased. I have often seen shovels used for covering the seed, and the work as expeditiously and effectually done as by the hoe.

Great care should be taken to select sound seed. If the grain has been much swelled by wet before it is housed, I have had cause to believe it cannot be relied on; and that this effort to sprout may as effectually destroy the germinating powers of the seed, as if the sprout had actually appeared outside of the grain.

If the grain has a mouldy appearance, it cannot be relied on, although the surface may seem perfectly sound. If, however, the heart of a few of the worst looking grains on an ear be superficially cut, with a very sharp knife, and it appears perfectly sound, also closely adhering to the harder sides of the grain, with which it should be firmly united, it is probable that the seed from that ear will vegetate. The grain at and near the point and but-end of the ear ought not to be planted; the organization of it is not so perfect, neither will it supply the infant plant with as much nutriment as the larger and more perfect grain.

Gather the seed, if practicable, when the husk is dry. After examining the grain, bind up the ear in its own husk. A ready band is formed by splitting the husk and tying two pieces together. Hang up the ears in a dry place, taking care that they do not touch each other. Soon after this they should be carefully examined. If moisture from the cob or husk have introduced mould, every particle of it should be brushed off from the outside of the grain. The husks opened wide, and with the ears hanging to them, thinly spread out for two or three days on the floor of a dry room, turning them as occasion may seem to require. In moist climates, and wet seasons, frequent examination may be found necessary, until the cob and husk become perfectly dry. The husk defends the grain from excessive cold, and prevents it from drying too fast or too much.

It sometimes happens, even when the soil is only moderately adhesive, that dashing rains, followed by a warm sun or drying winds, form a crust on the surface, which the plants cannot penetrate. In this case, they should be liberated by breaking or removing the crust. This may be done by a very short headed rake with nails driven through it. They form tolerable good tines, if their sharp corners be flattened with the hammer. When the cultivator suspects injury from crust, some few of the clusters ought to be daily exam-

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ined. If he observes any of the points of the plants turning downward, the whole field should be immediately liberated.

I once saved a small field in this way, although many of the roots of the plants were laid partly bare, and the stems appeared so tender, when they were uncovered, that serious damage was apprehended. The injury, however, was small when compared with the great advantage gained by this very severe operation; for the crop, on the whole, was a good one.

The very superior power of farm yard manure, to increase the product, and also hasten the maturity, of a crop of maize, has been clearly established with me.

Since my residence here, two fields adjoining each other were planted by me in corn. One had been much more exhausted than the other, and it was lightly manured. The other was cultivated without manure. Those who were well acquainted with both fields, and saw the scanty portion of manure which was applied to that which had been exhausted, concluded that the other field would produce the largest crop of maize. In this, however, they were greatly mistaken. The crop which had been manured very greatly exceeded the other. The ears, also, shot, filled, and ripened about two weeks sooner, although the exposure to the sun, and the earthy texture of both fields seemed exactly the same.

When the milk in the grain disappears, the corn plant may be cut off. However, the longer it stands, even after this, the better; provided it be cut off so soon as the leaves generally begin to cure, or die on the plants. If it stands longer, the fodder is often greatly damaged, and it is doubtful whether the grain is not as likely to be injured as benefited by continuing after this in the field: especially if the injury done by the birds and the quadrupeds be estimated. In the vicinity of Philadelphia, and similar climates, the fodder generally begins to cure, or die, on the stalk, before the plant is injured by frost. In this neighbourhood, and other places, where the sun is weak in the fall, and much cool, cloudy, and dripping weather occurs, the leaves of maize, (so far as I have yet observed,) continue green until they are killed by frost. Still the husk, especially the interior leaves of it, wither slowly, and the grain gradually hardens; but nothing like so rapidly as happens where more sun and clear weather prevail.*

* It would seem, however, that a white flinty corn, got by Dr. Dewees and Mr. Philips, from near the town of Erie, is an exception to what has generally happened here. It was planted about the 10th of May, 1817, and was full hard enough to be cut off the 21st of September. The fodder was also at this time curing, or dying a natural death on the stalk; notwithstanding the spring and summer, until the fore part of August, was so very unusually backward and cold, that it was generally believed the earliest variety of corn planted here, would be destroyed by frost before the grain was matured. This corn in size and form, is somewhat like the little yellow commonly planted in Pennsylvania; but ripens earlier, some say two weeks, others one, perhaps the truth lies between the two extremes. However, Major B. Wallace, who procured and sent the seed, says, "it is said to be the best kind that has been in this

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When tops are cut and blades stripped in the usual way, the general economy of the plant is greatly deranged, especially as at this time it is getting old and debilitated: of consequence, the grain, after this derangement, derives but little, if any, advantage from standing in the field; especially in dripping climates. I have seen the grain on many an ear of corn grown here become mouldy by remaining on the stalk in the field, after the tops were cut and the blades stripped from the plant.

It would seem, in this case, that mutilating the plant so extensively when it becomes debilitated by age, deranges the general economy of it so much that the vessels are no longer capable of performing their functions properly; and the sap in the plants exudes from the roots, and is quickly absorbed by the soil: also, that the space which had been occupied by the sap is filled with common moisture that injures the grain.

If the plants be cut off, the sap which issues from the wounds dries quickly on them, and prevents the further escape of it. The putting up the plants into heaps greatly procrastinates the drying and closing up the pores in them, which contributes to a longer flow of the sap, and filling of the grain.

It is evident that cutting off plants does not derange the general economy of them so much as to prevent a temporary circulation of the sap contained in the parts separated from the root, as branches and leaves are sometimes formed on logs after the outside of a house has been built with them, if the bark has not been stripped off.

The corn plant should be cut off close to the ground, or the shrubs will be found greatly in the way of cultivating the soil.

In the warmer and drier climates it may be set up in heaps as large as can be readily banded, and well formed. In dripping climates the heaps should be much less. To form them readily and well, two men take their arms full of the plants, and set the buts of them on the ground a small distance apart, leaning the tops together. One keeps those from falling, while the other sets up two more armsful in an opposite direction; then both proceed to finish

country. Mr. Rufus S. Reed, (whom I got the corn from,) last season planted the common corn at the same time he planted this; and there were not thirty bushels to the acre, and it was much injured by frost. This corn, worked in the same manner, had upward of fifty bushels to the acre, of good corn, and was dry and fit to pull about four weeks before the other, and received no injury from the frost."

Erie lies very considerably north of this, and the corn here was, that year, (to wit, 1816,) generally destroyed by frost. Dr. Dewees and Mr. Philips's crop of maize, grown from the seed sent by Major Wallace, was very luxuriant, but being a smaller variety than I have been accustomed to grow, I can form no tolerable idea of what it may have yielded to the acre. The ears, however, very considerably exceeded the size of those on which the seed grew Some of the best measured twelve inches long. There is a peculiarity in the economy of this corn, which I have not observed in any other variety. The interior part of the husk, in place of being compactly wrapped round the ear, is found, by moderately compressing the outside of it with the hand, quite loose and open.

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the heap. When this is done, two stalks, with the ears hanging on them, are linked together at the tassel ends; with these the heap is banded just above the ears on the stalks which form it. One stalk is sufficient for banding the top. This band should be placed where it will best diminish the diameter of the top, and also form that part of the heap below it, so as to run off the water arising from rain or snow expeditiously. The ears which fall off in handling the plants should be thrust into the heap just above the lowest band, so far that birds or wet may not injure them. The ears on the row which forms the outside of the heap, together with those hanging on the bands, should be turned inward to prevent injury from birds. A dog properly trained will prevent injury from the larger quadrupeds, and if the farmer keeps a sufficient number of cats, and manages them properly, long and well tried practice has convinced me he has little to fear from ground mice, rats, &c. These intruders often destroy much of the grain, and by burrowing under the heaps, greatly injure the grass grounds on which they may happen to stand.

The plants are generally cut off by the hoe. This is a tedious and expensive practice. A man with an old worn out scythe will cut off more than double the quantity he could cut with a hoe, and with much greater ease to himself. The scythe is crooked at the point in a form fit for cutting; some rags wrapped round the heel serve for a handle. While the labourer grasps the stalks with one hand, he at one stroke cuts them off with the other, close by the ground; and poising their buts with the point of the scythe, lays them in rows, perfectly straight, with very great expedition. A wooden handle would be an improvement to this very cheap and useful tool. This practice was introduced on my farm by a negro man, and banding the heaps with the stalks by another man of the same colour, previously to which much time and straw had been wasted in twisting bands for this purpose. The cultivator should never forget there are but few men so ignorant as not to be capable of teaching us something valuable which we did not know before. As the same may be justly said of books, we should patiently and carefully glean every valuable practice that may be gathered from either. I ought, however, to observe, that the low growing corns require but one band placed near to the top of the heap. This is soonest and best done by using straw in the same way as for binding a large sheaf of wheat.

So soon as the ears have become sufficiently cured for the crib, the corn should be husked; the fodder set up in heaps where it was husked. These may be as large as they can be readily banded, and well secured from wet. If no rain be suffered to fall on it after the corn is husked before the heaps are set up, it keeps better in this way than in mow or stack. The moisture in the tops and stalk causes it to mould, when a large quantity is closely confined together.

The farmer should feed his fodder before he commences feeding

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hay, as the cattle will eat the tops much lower down while they are succulent. The stalks being harder than most other litter, will be better tramped and enriched by an early introduction into the cattle yard.

The heaps may be hauled as they are wanted for feeding; by which means the stalks will get into the cattle yard with but little extra labour.

Saving fodder in this way is very cheap, when compared with the tedious processes of topping and stripping, which leaves the stalks and frequently the husks in the field.

Very hungry cattle will eat the husk after it has been stripped of the greatest part of the nutriment contained in it from being exposed to the weather. If the cattle be half starved, they will eat a considerable part of the corn stalks left in the field while they are softened by rain. They, however, derive but little nutriment from either.

If spring grain be sown after the maize, there will be still a much greater saving in gathering the fodder by cutting off the plant, as it may be set up in heaps where it grew; consequently, hauled but once in place of twice before it gets into the cattle yard. This is greatly in favour of the practice of sowing spring grain after the corn, and winter wheat on the clover lay following the former.

Having recommended the arrangement of my last crop of corn, as the best known to me, it should be observed, that so many plants as were left standing in it require a richer soil, trench ploughing eight or nine inches deep, and much more manure than was applied for it. I believe the crop would have been more productive, if only two plants had been suffered to stand in each cluster generally through the field, and but one where so much of the soil was occupied by stumps and large superficial roots.

It is certainly much better to introduce too few than too many plants. The loss from the first error is confined to deficiency in numbers alone. This loss is always more or less compensated for, in all cultivated crops, by larger ears, or more fruit from each plant than would have grown, even if the arrangement had been correct.

When the soil or atmosphere is crowded with more plants than it is capable of perfecting, the injury is generally extended to the whole crop. If the soil is highly and deeply enriched, either by nature or art, with a due proportion of animal and vegetable matter, the evil arising from too thick planting is not so great. Still, as the health and vigour of plants, as well as of animals, seem to depend greatly on a free or sufficient admission of atmospheric air, they should never be too thickly sown or planted. Here, again, the analogy between plants and animals is very conspicuous. If men be too thickly crowded together, they look sallow, become enfeebled, and premature death often ensues. The same exactly happens to plants.

The perpetual plougher and cropper feeds his horses and working cattle, because he is soon taught, by the failure of the animal,

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that it cannot be useful to him unless this be done. If he were equally as well acquainted with the analogy between plants and animals, it is presumed he would likewise see that the former can be of but little comparative value to him, if a sufficiency of nutriment is not also provided for them. Likewise, that this nutriment does not exist in the stimulating manures; as he already knows that notwithstanding salt may stimulate the appetite of his horse or ox, and that it, with other stimulants, render the food eaten by his family more agreeable, neither the one nor the other could live on these substances. In fact, agriculture never can prosper extensively, until farmers are generally convinced that plants, like animals, derive their nutriment from animal and vegetable matter alone.

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CHAPTER XXII.

How, and in what cases, mixed crops, formed with maize and low growing plants are profitable. On the cultivation of a mixed crop of maize, and the kidney bunch bean. Beans bear transplanting better than corn. They, and every other plant, grow most luxuriantly in a rich soil. They are a very lenient, also, a very profitable crop, if properly cultivated. The very close shade formed by their foliage, pulverises the soil more effectually, than is done by a naked fallow well prepared; they of consequence prepare the soil well for small grain. Observations on sowing buckwheat among corn. Also, on planting pompions and beans, with long running vines among it. Where the potato sells well for table use, it will be found the most profitable plant, to form a mixed crop with maize.

MIXED crops, formed with maize, and low growing plants, are profitable: especially, when the extent of soil is scarcely equal to the workers in the farmer's family. If corn be properly grown in this way, it may be said to occupy half the soil regularly through the field, and the plants grown between the rows of it, the other half.

When the plants grown between the corn, produce as much in proportion to the soil allotted them, as they would do if planted by themselves in a separate field, it should not be considered improper to divide the rent of the soil between them and the maize.

The only material advantage the corn derives from this arrangement, is a more extensive scope for the admission of sun and air. This advantage costs the farmer the extra labour naturally arising from complex cropping; the increased product is, however, considerable, and may in many cases, be obtained without adding much, if any thing, to the annual expenses of the farm.

Having discovered, that heaping up of the soil in ridges, when plants are cultivated, confines the roots of them too much, even when the intervals are wide, and also causes them to take very unnatural directions through it; this leads me to believe, that low growing plants, might be advantageously grown between the rows of maize, when they were much closer together than had been practised by me, provided the cultivation was level, and very superficial.

On the 23rd of April, 1814, I planted a patch with maize, leaving intervals of six feet between the rows, dropping the seed in clusters eighteen inches asunder in the furrows formed for planting, suffering but two plants to grow in each cluster. On the 7th of May, the corn plant being then about three inches high, one row of white kidney bunch beans was planted in each interval between the rows of maize. The furrows for planting the beans were formed about three inches deep, and four were dropped in clusters, nine inches apart in the rows.

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Lest the planting should fail, the soil was scraped off from a small spot of rich, loose ground, adjoining the patch, about two inches deep, and spread with beans closely laid together; these were covered over with the mould which had been scraped off; so soon as they were to be seen above the ground, a shovel was inserted under their roots; the plants thus taken up were carefully separated, and placed in a basket to fill up the deficiencies in the patch; no addition was made, where two plants stood, nor any pulled up, where the four beans originally planted had prospered; consequently the replanting was confined to where only one plant stood, or none of the seed had vegetated. Observation seemed to determine, that four plants were too many to stand in a cluster, and that they would have been generally more vigorous, if but two had been suffered to remain in each of them; but as this was my first and last experiment with beans, I cannot determine how many plants ought to have been introduced; therefore advise the cultivator, carefully to ascertain the proper number that should stand in the length of one perch in the row; also, whether drilling would not answer equally as well as clusters; for where obstacles do not obtain, this practice is much less expensive than dropping the seed by the hand.

It was ordered, when the beans were replanted, to put them carefully into the ground, up to where the seed splits, and forms its two first leaves; this was generally well done, still in some instances, but little more than the roots of the plant were covered; those plants dwindled, and produced but little fruit, while all which were properly transplanted, prospered as well as the rest of the crop; although some of them were placed beside those established from the original planting.

Thus it appears, that beans will bear transplanting far better than maize, for no good, but much injury generally occurs from replanting, or transplanting the latter, beside a plant or plants already established; these new comers, oppressed by their more powerful neighbours, seldom ear well, and frequently produce no fruit, consequently become useless exhausters, and in return, oppress the older and more powerful plants, which causes the latter to be less productive.

I have often transplanted and replanted corn, and to but little purpose, except when the original planting was early, and the vacancies in the rows long, or the right angles, if planted in that way, wide apart, and the corn for replanting, managed in the same way, as the beans were prepared for that purpose; with this difference, it should be taken up so soon as it germinates, taking great care not to injure the sprouts, either in removing, or planting the seed; the covering, not more than one inch thick, ought to be lightly spread over the seed, and the tapping with the hoe omitted; it will be, however, generally found better to supply these deficiencies by a few bunch beans, or potato sets spread in a small circle at some small distance apart, and placed at a proper depth in the soil.

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Frequent cultivation had eradicated the grasses from the ground where this mixed crop was grown. Corn had been annually planted on the greater part of it for eight or nine years, and of late, without manure; the first crop seen by me on it was tolerable, but that which immediately preceded the one planted by me, was injured so much by poverty of soil, and bad cultivation, that many of the plants did not get more than from three to four feet high, and were incapable of producing even valuable nubbins.

The ground was moderately manured, with long fresh dung, previously to ploughing; the cultivation of the plants was level, and very shallow, this formed a thin covering of loose, pulverised soil on the surface, which filled up the cracks in the ground, and to a considerable extent, prevented the injurious influence of drying winds, and the heat of the sun; this greatly favoured the fermentation of the manure, and also prevented much of its rich volatile particles from escaping.

The ears of corn were generally as large as any which had been before grown by me, except in some parts of the patch, where, from the inattention of those who hauled and spread the dung, the ground had not been so well manured. On those spots, the corn plants became sallow, so soon as the tap roots, tassels, and ear shoots appeared. The ears on these places were less, and did not fill out so well to their points, as the rest of the crop; which always happens at this trying crisis, when a sufficiency of nutriment has not been provided for the plants.

Rather before the corn plant should have been cut off by the roots, my working people were removed to another farm. This induced me to pull off the ears in the husk and spread them in the buildings to dry, rather than encounter the depredation which might occur from leaving the corn unprotected. The crop was not measured. It was, however, clearly seen, that it sustained a great loss from being pulled off too soon, notwithstanding the ears were cured in the husk. The grain continued loose on the cob until the whole was used. This never happens when corn is not cut off too soon, or removed too early from the stalk. The grain, however, always shrinks after the corn is gathered, and becomes more or less loose on the cob; these openings between the grains let in air to the cob, and also permit the moisture to escape more freely from it. This causes the grains to unite as closely together as they were before they began to shrink, unless the plants have been too early cut off, or the ears too soon husked, or pulled off from the stalk, for the cob shrinks quite as much as does the grain grown on it; consequently, an ear of corn is considerably longer when it is cribbed, than after it becomes properly cured; especially if gourdseed forms the greater part of the variety; for the open texture of the grain of this corn, causes it to carry much moisture into the crib, unless the weather happens to be unusually dry, after the plants have been cut off, and set up into heaps.

When the leaves had generally fallen off from the bean plants,

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they were pulled up by the roots, and set up in very small heaps, between the rows of corn, with their roots uppermost. This exposed the thicker part of the stem, as well as the root, to the sun and air, also the pod, for it turns downward while perfecting its fruit.

After being thus dried, they were threshed, and measured at the rate of full thirty bushels to the acre, allowing them to occupy half the patch.

The soil, shaded by their close foliage, was open and mellow as it is possible to conceive, almost as readily removed by the foot as an ash heap.

The bean crop appeared nearly, if not equally productive throughout, even where the corn suffered considerably from lack of nutriment. This proves that they require much less food than maize: consequently that they are a very lenient crop.

As one corner of the field had been highly enriched, this proves they are at least as productive in very rich soils, as in those which have been only lightly manured. For although the leaves put on a darker green, where a hogpen had been long standing, the plants were quite as productive there, or perhaps more so than in the rest of the crop.

This is opposed to the too general opinion that beans grow best on a thinish soil; but is not less true on that account. I have seen many plants which would grow on soils that were too thin to grow those which required more nutriment. But I have never seen one that did not prosper better on a rich soil, until it was rooted out by more powerful plants.

I am informed that if beans be hilled up while the dew is still on the plant, they mildew and become unproductive. As this would seem to be the most favourable time for ridging up plants, I am disposed to believe, that the real cause why beans are generally considered an uncertain and unproductive crop, is, that they are too commonly planted on a poor soil, and always either hilled or ridged up; and that poverty of soil, joined with the savage practice of hilling up this delicate plant, debilitate it so much, that unless the seasons are very favourable, it cannot be productive.

The foregoing experiment induces me to believe, that if beans were properly cultivated, they would not only be a very lenient, but also a very profitable preparatory crop, for wheat or any other small grain.

It also seems probable, that they will grow luxuriantly, if the intervals be only twenty-seven inches wide. If so, a good grass lay with a full second crop of grass turned under late in the fall, might readily produce at the rate of forty bushels to the acre, which, where dung is not plenty, would be a very valuable crop. It would nett the farmer quite as much, or perhaps more to the acre, than a good crop of wheat. It is a very lenient plant, also well calculated by its close shade to pulverise the soil, far better than it is possible to do it by the cultivation of a naked fallow: consequently the preparation of the lay for any kind of small grain, would be at least equal to

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any that could be readily formed by the application of no more enriching manure.

The cultivation of the bean crop will cost more than that of wheat. But boys or girls may readily harvest the former with despatch, without whiskey and the other extra expense which has been injudiciously attached to the harvesting of small grain. Beans are also threshed with but little labour, are in demand for exportation, and sell quite as high as wheat. They may be drilled in rows, or if it be found better, dropped in clusters, by the very cheap drill invented by Mr. Bordley.* This may be soon made by any farmer who knows how to use the tools commonly kept on a farm. A leather bottom to the seed hopper like that used for the American drill plough, would be a great improvement to it.

I consider the arrangement of my mixed crop of maize and beans much better than any other that has been practised by me. Two hundred bushels of shelled corn to the acre, (rating only the soil allotted for the growth of it,) seems no more than should be expected; provided the manuring be sufficient, the cultivation good, and the yellow or white gourdseed corns are planted. If the small early flinty corn be grown, the quantity will be considerably less. This will, however, greatly depend on the arrangement of the plants. They are much less than the larger corns, also more productive in ear shoots; consequently, that arrangement will be best which is most favourable to the introduction of the greatest number of plants, without manifest injury to the perfection of the ears. Much may also be done towards increasing the product of these small early corns, by a judicious selection of the seed. Especial care, however, should be taken in doing this, to preserve, and, when practicable, to increase its property of ripening early.

It appears the product of the corn plant alone was increased by this mixed cropping, for when the ground allotted for the beans was estimated, they yielded only thirty bushels to the acre. The same happens when potatoes or barley are grown properly between the rows of corn. If either be suffered to stand too close to the maize, the product of the latter is greatly injured. I have seen the ears on a row of corn very much injured by being planted not closer than within twelve inches of the outside row of a potato patch, although neither of the plants was ridged up, and the remainder of the corn patch was good.

I have often seen buckwheat sown among maize, but never without manifest injury to the latter, until after my removal to Philipsburg. Here I have observed both productive when grown in this way, also followed by luxuriant spring wheat. The volunteer buckwheat plants were generally destroyed by the frosts which happen in the early part of the spring. The corn was an early variety, and dunged in the hill, planted at right angles from five to six feet asunder. It may have escaped injury from the early and rapid growth of

* For a description of this drill, see his book on Hemb.

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the plants. The gathering of the crops, however, is complex, and the system of cropping rather severe.

Some farmers in that part of New Jersey where sand greatly prevails, say, that by planting pompions among corn, the crop is greatly benefited by shade. If this should happen, when maize is planted at right angles of about five feet, it certainly cannot take place when it stands sufficiently close to produce a full crop. In all cases observed by me, the pompion not only injured the maize greatly by its extensive shade, but also from putting a stop to the cultivation of it far too soon, by the running of the vines.

Beans, with long running vines, are often planted among corn. These entwine closely round the maize. This, together with the extensive shade formed by their leaves, greatly diminishes the product.

Where the potato will readily sell for table use, it is the most profitable plant to form a mixed crop with maize. If only a tolerably productive variety be planted, the crop ought to produce at least three hundred bushels to the acre, rating half the soil, or the ground allotted for the growth of this plant.

But the cultivator ought not to forget, that to obtain this product, also two hundred bushels of maize from two acres of land, the plants will require sufficient food: consequently, the ground must be well manured, and trench ploughed eight or nine inches deep. The potato sets should be planted immediately after the first cultivation of the maize; especially in high latitudes, where the former is often greatly injured by frost, merely from planting it at or about the time it should be planted in warmer climates. The time of planting, however, often depends quite as much, or perhaps more, on whether the potato perfects its fruit early or late. If the seasons be equally moist, the later the potato is planted the better, provided it be not injured by frost. Still the cultivator should recollect, that the injury done by the too intense heat of the sun is not so destructive as an early or unexpected frost. Likewise, that it often happens that the early planted potatoes are especially favoured by the seasons, and more productive than the late, even when the latter has suffered no injury from frost. Also, that the shade formed by the corn plant will greatly defend the potatoes from the injurious effects of the sun.

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CHAPTER XXIII.

On the cultivation of flax. Too little seed is sown. It is injured in new grounds by the shade formed by the trees. How the seed sown for this and other crops may be well coated with gypsum.

Flax requires a rich soil, grows well after Indian corn, potatoes, or turnips. It is probable the same will happen if it be grown after any other fallow crop, provided the ground be rich, or has been properly manured. It also prospers well on grounds recently cleared from their wood, except that the bark is sometimes injured from the shade of the adjacent trees. It should not, however, be sown on such ground, until after the hard and undecayed vegetable substances be well incorporated with the soil, and the weeds to which new grounds are subject, destroyed by the cultivation of a fallow crop.

When the land is rich or well manured, or has been recently cleared, it will be found best for small grain to follow the flax, and grass seed sown on it. When the grasses are sown on this plant, they are greatly mangled, and many of them pulled up by the roots when the flax is harvested.

Luxuriant crops of flax have been grown on grass lays without manure. Therefore, when farm yard manure cannot be applied, a good grass lay, with a full second crop of grass, may be turned under for the growth of this plant. But, as weeds and grass are very injurious to it, the soil should be cultivated previously to sowing the seed, in the same way as has been recommended for sowing small grain on a grass lay in the spring. Small grain may be sown after the flax, and grass seed should be sown on it.*

If gypsum can be had, the seed for both crops should be well coated with it. When water only is used for wetting the seed, too little of this substance seems to adhere to many of them, and numbers are nearly stripped of it in the process of sowing. Although that which falls off from the grain in sowing is incorporated with the soil, it does not seem to be as useful as if it remained in contact with the seed, for reasons which have been assigned.

There are many glutinous or clammy substances by which seed might be moistened, (some with and others without the aid of water,) and such as are in themselves nutritive; also inclining to be

* Flax is considered an exhausting plant, consequently it would be a far safer practice to grow it on a grass lay well manured and properly prepared. In this case it would commence a course or round of crops as is recommended for hemp.

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softened by the moisture in the soil, or by no means disposed to oppose or bind vegetation, as does tar when the seed of maize is coated with it. Some one or more of these, that may happen to be least expensive, or most readily obtained, should be used when seeds are rolled in gypsum.

In England, two bushels of the best flaxseed are sown to the acre, and when the seed is considered not so good as it ought to be, three bushels are sown.

In this country, one bushel is generally considered sufficient to the acre. This, however, cannot be enough, although but few fine linens are made here.

Therefore, notwithstanding I do not profess to be sufficiently acquainted with the properties of this plant to dictate the quantity of seed which should be sown to the acre, I advise the cultivator to consider that the branching of these plants will be less when they stand thick enough on the ground, and that the flax is greatly injured by branching out into limbs, in place of producing long well formed stems. Also, that the growth of weeds is by far less encouraged when the plants stand sufficiently thick on the ground.

This plant is not readily injured by frost, and the prosperity of the crop depends so much on early seeding, that the farmer who prefers his interest to the erroneous practice of waiting until the ground be warmed, will act wisely if he sows early.

If weeds appear in the crop, they should be carefully removed by the hand before the plants have grown so high that they will not rise up after being pressed down by the feet of the weeders, who should not be suffered to enter the patch with shoes on their feet.

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CHAPTER XXIV.

On the cultivation of Hemp.

I AM still less acquainted with hemp than with flax. But there is a practice in the cultivation of this plant, which I know to be wrong. That is, many farmers have their perpetual hemp patches. These are annually cultivated, and as the plant requires a rich soil, manure is frequently applied.

This makes the patch, in proportion to its size, stand much in the same relation to the farm, as a Maryland tobacco patch formerly did. As the latter has been one of the principal causes of greatly exhausting the soil in many parts of that state, I would advise those who keep perpetual hemp patches, to alter this irrational practice.

Where this valuable plant is grown, it should form part of a course of crops, so that the grasses may properly intervene. I am well informed that it grows luxuriantly on grass lays; consequently, an alteration in the cultivation of it, may be readily, as well as profitably effected.

Notwithstanding the shade formed by this plant destroys many weeds, the lay should be well prepared for the growth of it, in the way that has been recommended for small grain sown in the spring. Manure will be necessary, unless the grounds be rich and deep, as the plant is powerful as well as large, and seems to return but little back to the soil. Still, in place of the manures being very frequently applied, once for each round of crops will be found sufficient. A much more considerable breadth of soil than the scanty limits of a perpetual hemp patch, will be enriched by the same quantity of dung, which, by being improperly used, had been exposed to much useless waste.

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BOOK III.

ON VARIOUS SUBJECTS.

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CHAPTER XXV.

Observations on the quantity of wheat that should be sown to the acre; also, on the proper time of sowing it. How any material injury from the Hessian fly may be generally avoided. Remarks on the generally prevailing opinion that the wheat plant is smothered by snow. Observations on drilling wheat; also, on spring wheat.

FULL two bushels of wheat should be sown to the acre, if put in as early as the depredation committed by the Hessian fly will admit. If sown later, the quantity ought to be increased in proportion as the season advances, up to not less than three bushels to the acre, if sown very late. As the season advances, the soil becomes less capable of promoting vegetation, and the seed perishes in due proportion.

Very young and tender plants cannot withstand the vicissitudes of inclement seasons near so well as those that are more firmly established; and many of them perish of course. The plants that survive do not tiller near so much as those grown from seed which has been early sown.

Local causes, as well as latitude, alter climate so much that no certain time can be fixed on for seeding, so as to suit in every part of our extensive country. In general, however, wheat may be safely sown just before, or immediately after, sufficient white frost appears either to kill, or greatly cripple, the Hessian fly. Still, it sometimes happens that white frost is not, as usual, succeeded by other frosts until the Hessian fly has recovered from the injury inflicted on it by the first frost, or frosts. In that case, great mischief is sometimes done by this destructive insect. This is, however, an evil which cannot be avoided, without generally seeding too late, and as it seldom occurs, is not so much to be dreaded.

Before the appearance of the Hessian fly, wheat was often sown too early. Many had to turn in cattle to eat it down, or it would have jointed in the fall. This practice uselessly exhausted the soil, by feeding the plants on it longer than is necessary.* The cattle destroy the crown of the plants, leaving the lateral and less productive shoots for growing the crop. They also pull up many of the plants by the roots, and trample others into the ground. This forms holes in which the water lodges, and the grains, with the young grass plants growing in them, are destroyed by frost.

When wheat is not sown until danger from the Hessian fly has

* Nothing is gained by this. The long extensive leaves, &c. grown in the fall are commonly so much injured by frost in the winter and early part of spring, that they fall off, and new ones are to be formed.

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passed by, the soil is not consolidated by time, more than is necessary for the growth of the crop. A long and useless continuation of the plants on the soil in the fall, renders it less capable of affording sufficient nutriment for them, when they are perfecting the grain; which is of all others, the most trying crisis. Too early sowing also encourages the growth of hardy weeds. These being firmly established in the fall, too often take the lead in the spring, and greatly injure the crop.

It appears to be generally believed, that late seeding favours mildew, and observation seems to confirm this opinion. I never sow wheat, however, until it is supposed that risk of material injury from the Hessian fly has passed by: yet I have observed that my crops have suffered more injury from mildew, than those put earlier into the ground. As popular opinion on subjects which are not well understood, may be either right or wrong, I am not disposed to give up the evident advantages derived from sowing later than others, until I am better informed: particularly as it clearly appears that deficiency of seed, frequently united with a soil too thin to mature a profitable crop of wheat, is sufficient to injure the product of this plant, to a great extent; especially when it happens to be sown very late. There is, however, a very great difference between sowing so late, that the plough and harrow are frequently stopped by hard frost, before the farmer gets in all his seed, and that of sowing as soon as material risk of injury from the Hessian fly, has passed by. The first mentioned practice is evidently wrong. The last may be, for aught we know to the contrary, be exactly right: even if well tried practice had not clearly determined, that wheat cannot be sown sooner, without risking ruinous injury from the insect.*

In this State alone, latitude and local causes alter the climate so much that the plough and harrow are stopped by hard frost, at least two weeks sooner, in some situations, than in others. Yet, I find the farmers where I now reside, fix on the same time for seeding, that was considered proper by the cultivators in the neighbourhood where I formerly lived. Both cannot be right, as the plough is stopped by hard frost here, from ten days to two weeks sooner than the same generally occurs there.

The quantity of seed recommended by me, is as contrary to the opinions of farmers in general, as it also is to Mr. Bordley's book on Husbandry. He says that "wheat sown in England, from two to three bushels to the acre, yields great crops; that two bushels to the acre, sown in Pennsylvania or Maryland, would yield straw without grain."

Mr. Bordley certainly never did investigate the subject, or he would have known better. I have long been in the habit of sowing two bushels to the acre, and have generally gathered far better crops than my neighbours who sowed less.

* The surface of a field of very early sown wheat, commonly presents a russet and deadlike appearance in the spring, while that sown later, but not too late, looks green and vigorous.

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It so happened once, that by mistaking the measurement, of a small field, much more was sown on it. It yielded considerably more grain, and much stouter straw than some other wheat, sown at the rate of two bushels to the acre, the same season, and a little earlier. Every person who saw the little patch of thick sown wheat, said it looked beautiful, but that it stood vastly too thick on the soil; that the straw would spindle, and fall to the ground. The result, however, was immediately opposed to this. The straw of the thickly sown wheat, was preferred for thatching my barracks, by an Irishman who had been accustomed to that business in his own country.

Since I removed to Philipsburg, I sowed in the fall of 1814, a patch of wheat, at the rate of two bushels to the acre, and intended to sow another patch at the same rate. It, however, so happened, that the seedsman who sowed the last, got bewildered in consequence of being accustomed to sow only one bushel to the acre, and the patch was sown at the rate of nearly four bushels per acre.

Both fields promised large crops, until the plants were sadly affected by mildew, which prevailed that year very generally, so far as my observation and information extended. Neither of the patches yielded more than half a crop, but the thickly sown, produced the most and best grain. This may have happened from its standing on high ground, or from the stems growing on a greater number of original roots, for the plants tilled less than the patch which had been thinner sown.

Mr. Bordley, in his book on Husbandry, intimates, that the soil and climate of England are calculated to grow better crops of wheat, than can be grown in this country. With respect to soil, it may be justly observed, that we have both as good, and as bad as is to be found in other countries. Our climate, however, seems to be better calculated to ripen heavy crops of wheat, than the climate of England. We have generally a clear sky and genial sun. In that country, cloudy, dripping, foggy weather, joined with the weak effect of a distant sun, often proves fatal to the ripening of wheat crops. We are also told by nursery men, who have practised their profession in both countries, that plants of the same description, will grow nearly a much in one year here, as they commonly grow there in two. This seems to prove that our climate is better for vegetation, and that the soil must be at least equal to that of England.

That Englishmen generally cultivate wheat, and almost every other plant, much better than they are commonly cultivated here, we ought to acknowledge with shame; they also generally improve their soil, and we but too commonly impoverish ours; these things are, no question, worthy of praise, and thus far, we should follow their laudable example. Grain and grass seed are also sown much thicker in that country than here, and in this, Englishmen act wisely. When these subjects have been wisely considered, and appreciated in this country, we shall do the same, and, where useless, and very injurious weeds, now occupy the unnecessary space, left

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between the plants, valuable vegetation will appear. Good cultivation and management, will certainly place our field, on at least an equal footing with those of England. Then, but not until then, it will be clearly seen by all, that the climate of this country is very superior to that of England, for the growth of plants generally, and that the soil is at least equal.

It would seem that the first cause of sowing seed too sparingly, in this country, is developed in our recent settlements, made in the back-woods. It too often happens, that when these settlements are first commenced, a scarcity, not only of seed, but also of food prevails. It has been such, as to induce some cultivators, to take up and eat their potatoe sets after they had been planted. This seems to have determined them, to spread their seeds very thinly over the soil, to increase the product of each one of them as much as possible.

No question but a much greater scarcity of seed and food prevailed among the first European settlers of America, as they were often in a starving condition; this would naturally induce them to sow and plant very thinly; profuse tillering was the natural consequence in a virgin soil, particularly, when the wheat was sown early.

Before the Hessian fly appeared, many of the farmers on the eastern shore of Maryland, commenced sowing wheat, about the 20th of August; this was very early for that climate; such, however, was the practice, and frequently with not more, and sometimes less, than three pecks to the acre. It would seem from this, and various other circumstances, that a false economy induced the first settlers, to continue the practice of sowing by far too little seed, although it was immediately opposed to the practice of the country from which they had emigrated.

They, no question, at first believed this profuse vegetation, originated in the superior soil and climate of the country they had adopted; this seems also to have led them to believe, that where nature had made such ample provision for the growth of plants, but little attention to manure was necessary, until their crops were reduced by impoverishing the soil; this of course altered their opinion, but it would seem, as too commonly happens, lead them into an error still more fatal; namely, that the soil and climate in this country, were incapable of producing such luxuriant crops as were generally grown in England.

Be this, however, as it may, the opinion has very generally prevailed, although nothing can well be more repugnant to common sense and observation, and the cultivation of wheat, with not more than one bushel sown to the acre, has continued to prevail. This was too generally sown on an exhausted soil, without manure, until the Hessian fly appeared. A little before the appearance of this insect, the average crop of wheat, on the eastern shore of Maryland, was estimated at about six bushels to the acre, and that of Pennsylvania, where more attention had been given to grass and cattle, at about ten bushels per acre.

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This apparently insignificant insect, however, compelled late seeding, which, together with the poverty of the soil, greatly lessened the number of wheat plants, and the stems produced by tillering; these causes compelled farmers, either to abandon the cultivation of wheat, or to manure their grounds; many preferred the latter, and the beneficial consequences arising from this supposed calamity have been clearly evinced; one corner of many a field which had been exhausted by perpetual ploughing and cropping, without proper attention to grass and manure, now produces more than the whole of it formerly did, and with much less labour and expense. In this case, it is very observable, that rational industry, has sometimes the power of converting evil into good.

Farmers might have long since seen, that one bushel of wheat sown after the depredations done by the Hessian fly ceased, would not, if seasons good and bad, and the different periods at which it must be sown be averaged, produce near so many plants, as a bushel sown much earlier. That many of those plants would perish, during the inclement weather, in the fall, winter, and spring, and that those which survived, would tiller but little, especially in a thin soil: consequently, could not produce near so many stems, or ears, as the same quantity sowed much earlier.

Now if those facts had been duly considered, they would have long since seen the propriety of increasing the quantity of seed, so as it should, at least, introduce as many ears or heads, as were formerly introduced by early seeding.

If they had investigated this highly interesting subject still further, reason and observation would have informed them, that the same number of ears, supported and nourished by a greater number of original roots, must be capable of producing much more, and better grain, than it is possible for the same number of ears to produce, which are supported and nourished by a much less number of roots of the same description.

As the thicker sowing, introduces many more original roots than thinner sowing, it must be more productive, even when only the same number of stems and ears are produced by both modes of seeding. Thick sowing, acts somewhat like suckering; it reduces the number of stems from each plant, and if the grain be sown late, as well as thick, the plants of course, tiller still less, and unless the crop be sown so late as to favour mildew, more than wheat sown very early, it will certainly yield more, and better grain.

To illustrate this, I might refer to a number of fruit bearing tillering plants; it may, however, be sufficient to observe, that most good farmers sucker maize, and those who are in the habit of doing this, know full well, that three stalks grown in one cluster from three grains, will yield far more and better grain, than three stalks grown in the same way from but one grain.

If wheat could be suckered to one original stem, grown from its own grain, without introducing too much labour, the crops would exceed credibility, if seed enough were sown to produce a sufficient

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number of plants. The stems produced by tillering, form roots, but like all other roots formed by suckers, they are not, neither will they become so perfect, while they remain attached to the parent plant; like young animals, they more or less depend on it for their support, and like them, prove powerful exhausters, until they are separated from it; this is clearly seen in our orchards, in fact it may be seen, by the attentive observer, wherever vegetation exists; here again, the analogy between plants and animals is very conspicuous: but to return, the parent plant, and its offspring, are, when wheat is sown thin and very early, closely matted together, and confined in one tussock: consequently, are far less capable of gathering nutriment, from the soil, than the same number of original roots which are regularly spread through it.

Wheat cannot be sown in any way so as generally to suppress tillering: if sowing, however, be deferred, until material injury from the Hessian fly is not to be expected, and seed enough to be sown, tillering is greatly suppressed.

There is certainly no natural cause which should deter us from sowing wheat, and other grain or grass seeds, full as thick as they are sown in England. As agriculture has been more highly improved in that country, than most other parts of the world, and numerous experiments have been made by gentlemen of superior farming abilities, to ascertain the proper quantity of seed which should be sown, and they, as well as the plain practical farmers residing there, find that too much seed is not sown, why should we hesitate to give this interesting practice a fair trial? especially, as those who have sown liberally, in this country, are fully persuaded, from comparing their present, with their former crops, and also, by comparing crops with their neighbours, who sow less seed, that plentiful seeding is by far the most productive practice.

Very many millions of bushels of grain have been lost to the United States by pursuing a different method; some gentlemen in England promised the nation a great saving in seed, from using the drill plough: however, after this instrument had been longer, and more generally used, it was clearly determined, that very little, if any, seed could be saved by it, without more injury to the product of the crops than the value of the grain saved by sowing thinner.

If that invaluable instrument, by which seed may be so correctly sown, and the plants well cultivated, has been found incapable of reducing to any considerable extent, the quantity of seed sown to the acre in Britain, we have still stronger reasons to believe, that too much has not been generally sown broadcast in that country.

Here, however, I beg leave to observe, that notwithstanding it seems probable, Mr. Tull's intervals were generally too wide to grow a very large crop of wheat, and that sowing in double row was not calculated to counteract that error to any very considerable extent, still there is reason to believe, that the improvers on his system have gone into the contrary extreme; that much wider intervals than is at present practised, would grow more productive

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crops than have yet been obtained; that much seed might be saved by this system of management, and at the same time, a sufficiency introduced in the rows, to suppress a profuse and injurious tillering of the plants; provided the practice of double hedge-row sowing be avoided; this mode of sowing and planting, may be very greatly multiplied on paper; it, however, multiplied but little, whenreduced to practice in our field, and most generally is very injurious to the crops.

The roots and tops of plants require space in proportion to their size and other properties. When arranged in single rows, or at right angles, in that way which gives their roots and tops every possible advantage consistent with a sufficiency of plants to grow a large crop, they will be more productive than when grown in any other way. The wheat may be sown in single rows, no wider apart than to admit a small horse to walk between them without injuring the plants materially. The intervals may be either increased or decreased in width, as may, from experience, appear best calculated to favour the experiment. The cultivation should be level, and very superficial, and, in intervals of this width, may be so perfect that wheat may be sown and cultivated on a speargrass lay, well turned and prepared, with but little more labour than on a clover lay.

I had never seen spring wheat grown before the year 1815. It was then sown by Dr. Dewees and Mr. Philips, at the rate of full two bushels to the acre. The crop was luxuriant, and the heads large and well filled. The field on which it grew adjoined the Mushanon creek, was level as well as low, and a part of it considered too retentive for wheat. These circumstances, added to its ripening but little sooner than oats, seemed to favour mildew; especially as the wheat sown the preceding fall was greatly injured by that disease.

The result of this crop accidentally determines that some varieties of spring wheat are vastly more susceptible of injury from mildew than others.* The farmer who was sent about one hundred miles west of this place, to procure the seed, was informed, when he arrived in the neighbourhood where the spring wheat was grown, that there were two varieties of it, and that the bearded was subject to mildew when the smooth-chaff escaped this disease. He, of course, determined to procure the latter. It, however, so happened when the wheat shot out into ear, that a slight mixture of the bearded appeared in every direction through the field. Every plant of this description was excessively injured by mildew, while the smooth-chaff growing in contact with it escaped.

This spring wheat seems to be equally as subject to smut as wheat sown in the fall. That disease generally prevailed in the year 1817, in the back-woods settlements, as far as my information extended; but not so as to do very great injury in this neighbourhood, except

* It is probable that if the subject were properly investigated, the same difference would be found to exist in wheat sown in the fall.

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in a few fields. In this case, the spring wheat appeared to be quite as much affected by smut as was that sown in the fall.

The bread made with the flour of the spring wheat grown here, is not as white as that obtained from wheat sown in the fall. The colour, however, is not dark and ill looking, like the bread made of rye flour. On the contrary, the slight yellow tinge of the bread made with the flour from our spring wheat, communicates a rich appearance, which seems to compensate fully for its not being so purely white.

My family, neighbours, and myself, prefer the bread made of the flour of the spring wheat. We believe it has an agreeable flavour, which, though it may be readily tasted, cannot be described so as to be well understood. We say it is sweeter than other bread; that is, it is more agreeable to us; but this is by no means descriptive of the pleasant taste of it.

It is probable that the slight yellow tinge of the bread made with the flour of this wheat, will make it less valuable for exportation. It will, however, be found invaluable to those who reside in high latitudes. By cultivating it, the risk of injury from winter's frosts, &c. is avoided: so is, also, any extensive damage from the Hessian fly. As it has once escaped mildew when fall wheat was generally greatly injured by this disease, the same may again, or, perhaps, generally happen.* It may be cultivated with less labour, as much less water furrowing will do for it than for fall grain. The variety grown here is full as productive as any wheat known to me. The skin of the grain is thin. It yields quite as much flour to the bushel as fall wheat. Some say it yields more. I very much doubt, however, whether the product will be so great, or the flour as good, when this wheat is sown in warmer and drier climates. It is certain that the grain of oats sown here, is larger and better, and the product greater, than is obtained from this plant in the warmer and drier climates below us.

Spring wheat has been cultivated only three years here; it is, however, evident that it prospers best when sown as early as frost will permit it to be done: also, that two bushels to the acre is not too much seed; but it remains doubtful whether more seed would or would not increase the product.

The farmers in the back parts of Pennsylvania, say wheat is smothered by snow: especially when a crust is formed over the latter by hail or sleet. They also tell us, that if cattle be driven through the field, so as to break the crust into pieces, the air is let in and the plants are not injured. This may be correct. No observation of mine, however, confirms the theory.

Snow seems to prevent the escape of much heat from the earth,

* As other spring wheat grown in contact with it was ruined by mildew, it clearly appears that the cause which produces this disease existed in as full force as it did earlier in the season, when the fall wheat was very much injured by it.

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and a compact covering, formed by frozen hail or sleet, may more effectually confine it. It, however, seems doubtful whether enough of heat could be gathered and confined in this way, under the snow, to produce a sufficient fermentation to destroy the plants. But be this as it may, it is very obvious that as soon as the snow melts off the ground in the spring, the wheat plants often dwindle, and a considerable proportion of them are quickly destroyed.

As the farmers confidently assert that this injury is much greater when hail or sleet closely covers the snow, it is difficult to suppose they could be readily mistaken in this part of their theory: yet they are very often greatly mistaken in things which it would seem might be more readily understood. It is also worthy of remark, that the thick and solid ice often formed on watered meadow, is generally believed to preserve the tops and roots of the grasses under it.

It is likewise certain, that when wheat is sown in high latitudes, on a soil recently cleared from its wood, the crops are seldom injured during winter, or early in the spring; except in such hollows in the field as may happen to gather and retain the water falling on it. The cause of this is so evident that it cannot be controverted. First, the open texture of those soils formed by the vegetable matters not yet sunk into decay, filters off the superfluous moisture. Secondly, the rich animal and vegetable matters contained in the virgin soil, cause the plants to become healthy and vigorous: of consequence, they are far better calculated to withstand the vicissitudes of inclement seasons.

Now, if the plants be smothered by snow, or a combination of it with hail and sleet, I cannot see why they so generally escape on the new grounds, while they perish on those that have been longer cultivated: more especially, as I observe the injury is much the greatest where long continued and severe cropping, without attention to grass or manure, has not only reduced the large body of partly decayed vegetable substances, which abounded in the soil when it was first cleared from its wood, but also reduced the animal and vegetable matter so much that the ground, soon after it was ploughed, became a compact mass, unless a very considerable proportion of it was sand. In the latter case, the texture does not become compact, but being stripped of animal and vegetable matter, it remains equally inert and incapable of furnishing sufficient food for plants.

In every climate where I have been, a large number of wheat plants perish during inclement weather, from poverty of soil alone: particularly during the freezing nights and thawing days which generally take place in the latter part of winter, and early in the spring.

In the lower parts of this State, farmers believe that plentiful snows preserve the vigour of the wheat plant, and enable it the better to withstand the severe trials it has to encounter in the latter part of winter, and early in the spring.

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Many wheat plants perish in retentive soils, which contain a sufficiency of animal and vegetable matters, when due attention has not been given to ridging and water furrowing them properly. This, also, very frequently occurs in England, which Mr. Bordley, and too many of our farmers, have considered much better than this country, for the growth of wheat. This evil, however, does not so commonly occur there, as it does here. Englishmen frequently spend more money in under draining retentive soils, than would purchase the fee simple, in the same number of acres of the richest and best land in our back country, with a log dwelling house and barn, and many acres of cleared ground included in the survey. It is true, the greater part of this labour might be generally avoided, and the crops rendered still more valuable, by forming under drains with the furrow slices, and the tops of the grasses turned under the soil, when the grounds were turned up for fallow crops. But their injudicious attachment to old grass grounds, has excluded a proper system of convertible husbandry.

From what has been advanced, we may rationally infer, that if farmers in high latitudes, would keep their grounds well stored with animal and vegetable substances, and pursue a proper system of husbandry, we should hear but little complaint of grain crops being smothered by snow, &c. Notwithstanding, a sufficiency of nutriment for the plants, and proper ridging or water furrowing are indispensable in every climate where I have been, the injury arising from the neglect of them, is vastly greater in high latitudes. So much so, that I am fully persuaded the growth of winter wheat has been abandoned, or nearly so, in many of the long formed and very populous settlements in this country, where it might have been, and yet may be grown, with extensive success. Where good grasses and cattle abound, winter wheat may also abound, if the soil be sufficiently enriched, and proper provision be made to run off that superfluity of moisture, which generally prevails in high latitudes; and which induces farmers, who have not sufficiently investigated this very interesting subject, to assert that such settlements are excellent for grass or grazing, but very unfit and improper for wheat, more especially for that sown in the fall.

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CHAPTER XXVI.

Remarks on the cultivation of rye. Also, on its not being so hardy a plant as wheat. It is subject to much fewer diseases than wheat. Observations on spring rye.

Rye requires full as much seed to the acre as wheat. It also tillers in proportion to the time it is sown: therefore, the quantity of seed should be increased as the season advances. As it is seldom, if ever, injured by the Hessian fly, it may be early sown. Yet it would appear, from the best information I have been able to gather, that the earliest sown winter grain is injured the most by the cause (be it what it may,) which produces the effect that farmers term "smothered by snow." How this happens, is a difficult question, as the increased size, and deeper rooting of the plants, appear calculated to increase the vigour of them. It seems to favour the idea, that the profuse vegetation promotes a more powerful fermentation.* I have, however, never heard any person attribute the destruction of the plants to this cause.

Rye is not so valuable as wheat, but in some cases, may be more profitably grown. The cultivation for it ought to be quite as good as for the latter grain.

It has been found very productive, when grown on a good soil, well cultivated, and merits much better treatment than it generally obtains. Farmers have discovered, that it is capable of contending with bad cultivation, and an impoverished soil, and seldom allot better for it: consequently, they too generally gather scanty crops.

In England and some other parts of Europe, fatal consequences have occurred from eating the bread made with the flour of this grain. This is caused by a disease which takes place in the grain, while growing in the field. The affected grains grow out in a form resembling horns, and become much larger and longer than those that are sound. These horns contain a mixture of black and white powder. When the disease is extensive, a sufficiency of this powder is mixed with the flour obtained from the uninjured grain, to destroy those who eat the bread made of it.

Some people in this neighbourhood, gather the diseased grains, to poison flies. These affected grains, however, have never appeared here in sufficient number, to do any perceptible injury to the bread.

So far as my observation and inquiry extend, rye suffers more than wheat, in the back parts of Pennsylvania, from being (as farmers term it,) smothered by snow. This may arise, in part, from a

* That is, if fermentation be the cause which produces the effect.

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thinner soil and worse cultivation than is commonly used for the latter grain. The generally prevailing opinion, however, is, that rye is a much hardier plant than wheat. Still, it would seem that this supposed hardiness of rye, arises from its being better calculated to live on less nutriment, and also to contend with a bad cultivation. If both plants be well cultivated, on a soil sufficiently rich, and in other respects equally favourable to the growth of either of them, it will be found that the wheat is better calculated to withstand the bad effects produced by inclement seasons, in the back parts of Pennsylvania. On what may happen elsewhere, I am not so well prepared to hazard an opinion.

Rye is not subject to near so many diseases as wheat. It is therefore, a much more certain crop, provided it be equally as well cultivated, and on as good a soil.

I have never seen spring rye, therefore cannot say any thing practically of it. It was sown last spring by a few farmers who reside not far from Philipsburg. They speak highly of it, and say it is equally as productive as that sown in the fall. If their report be correct, it should be sown in preference to the latter, especially in high latitudes.

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CHAPTER XXVII.

On the cultivation of barley, and the quantity of seed that ought to be sown to the acre.

Barley, when sown in the spring as early as frost will permit it to be done, requires full three bushels to the acre. If later sown, the quantity should be increased as the season advances. It also tillers more or less, in proportion to the time it may happen to be sown.

Most farmers sow but two bushels of this grain per acre, and I have never sown more than three bushels to the acre. I have, however, seen four bushels sown to the acre. When the plants were about four or five inches high, they seemed to be so very thick on the ground, that if the field had been mine, I would have dragged a great many of them up by the roots, with the tined harrow. This, however, would have been wrong, as I do not recollect ever to have seen barley grow stouter, or ear better. The owner of the field had been in England, and but a little while returned from that country, before the barley was sown. More than four bushels of barley is sown to the acre, by some cultivators in England. Still, I would advise the farmer not to sow more than three bushels to the acre, except on a small scale, until the subject is better understood.

I believe winter barley will require more, or at least quite as much seed, as that sown in the spring; but of this I know nothing practically, having always sown in the spring. I would advise every farmer to do the same, as the risk of inclement seasons is avoided by this practice. The soil being recently cultivated by putting in the crop with the hoe and tined harrows, is in a far better state to mature the grain, than it would be after lying through the winter, and a part of the fall. Much fewer weeds are introduced, and the grass seed sown immediately after the cultivation, prospers much better. Much less water furrowing will suffice. This will save labour and furnish a surface better calculated for mowing the grasses, and inning them after they have been made into hay. These very obvious advantages are sufficient to induce the farmer to prefer sowing grain of every description in the spring, whenever the practice will be, in other respects, equally convenient and profitable to him.

The barley with six rows of grain on each head, has been the most productive in my practice. This plant, like most others, delights in an open, free soil. Great crops of it have, however, been grown on very stiff, retentive clay, when the soil was rich, ridged up, and properly water furrowed. The grain of that grown in high latitudes, so far as my observation extends, is larger and heavier than that of the same variety, grown in the lower latitudes.

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CHAPTER XXVIII.

On the cultivation of oats. Barley may be more profitably cultivated than oats on rich soils, even for the purpose of feeding domesticated animals. On harvesting grain.

Oats require full as much seed as barley, and the same increase in quantity as the season advances, for reasons which have been assigned. They are a productive crop in high latitudes. In such situations, the grain of some varieties becomes nearly as large and as heavy as the grain of barley grown in lower latitudes. Thus the grain of the oat grown in the glades, where the height of the ground causes the climate to be cold, is much celebrated for its size and weight. Seed procured from the glades, however, and sown in warmer climates, quickly degenerates, until it attains that size and weight which are consistent with the soil and climate to which it has been removed. After this, if it be in the hands of a judicious farmer, it will degenerate no further. On the contrary, if it be formed of mixed varieties, (as is too generally the case with the greater part of our seeds,) he will gradually improve this degenerated mass by growing or picking out the inferior kinds. This theory, sanctioned by the long and well tried practice of many judicious cultivators, is equally applicable to every other kind of seed. It is not, however, so soon, and, of course, not so readily observed in some of them, as it is in the oat.

Oats ought to be sown as early in the spring as the frost will permit. They are generally sown after a slight and very ineffectual cultivation. The soil should be as well prepared for them as for barley. If this is not done, very luxuriant crops cannot be expected. The farmer should, however, consider that any soil, which is not very retentive of moisture, if it be sufficiently rich to produce luxuriant crops of oats, is also capable of producing the same of barley, if properly ordered. The latter, where it is in demand, sells much higher than oats. It also weighs considerably heavier: therefore, is greatly superior for feeding domesticated animals. It is richer food than oats, but being also well covered with a chaffy husk, this, with its other properties, renders it equally proper for feeding stage or saddle horses. Barley is the common food for this animal in those countries which produce the fleetest and best formed horses in the world.

The only advantage which oats have over barley, is that they may be more perfectly grown in soils either too wet or too poor for the latter. The roots of the oats are better calculated to contend with poverty, and the plant is able to live on much less nutriment. It

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can also better withstand a superabundance of moisture, and bad cultivation than barley.

I have, however, seen oats greatly injured by a superabundance of moisture when growing on soils which might have been laid sufficiently dry for that crop, if due attention had been given to water furrowing the ground properly.

If the farmers in our back-woods settlements would grow barley on their better grounds, in place of oats, for feeding their live stock, it would be the sure and certain means of establishing many breweries in a very short time. The present scarcity of them arises principally from the impracticability of procuring, in time, a sufficiency of barley to make the business even tolerably profitable until some very considerable time after the commencement of it. The establishment of breweries would not only open a market for our produce, but also eventually cause much less whiskey to be drunk. The too free use of it seems to be the principal cause of most of the evils which prevail in new settlements.

Custom has induced farmers generally to believe that it is an improper and wasteful practice to cut either wheat or rye with the scythe and cradle. If the grain be neither lodged nor entangled, it may be cut off as clean by the scythe and cradle as by the sickle. If it be properly gathered and bound, but little, if any, more loss will arise from gathering it in this way. If the grain be cradled in proper time, it shatters less, on the whole, than when it is reaped and secured in the usual way. It is readily granted that if grain be cradled and reaped at the same time, it shatters more by the former practice. It should be recollected, however, that the very tardy progress of the sickle greatly increases the shattering, by procrastinating the harvest so long that the chaff opens, and much of the grain falls out. Whereas the rapid progress of the scythe and cradle cuts off the grain, before any material loss from shattering can take place, if the cultivator commences in time. No evil, but much good, will arise from beginning early. This not only prevents shattering, but also the risk of encountering the various injuries to which the crop is exposed by useless delay. Some farmers of the first respectability assert, that practice and observation have convinced them, that the grain, and also the flour, are best when wheat is cut much before the usual time. This, however, does not accord with my practice. The middle course, between the extremes of cutting very early, or at the usual time, will be found the best: except when mildew occurs. In that case, wheat should be cut immediately after it can be determined that the disease is severe. If the crop is only slightly affected, it is far better to let it stand until the grain be fit to cut.

Many judicious and well attested experiments determine, that when wheat is badly injured by mildew, the grain gets no better, if it be suffered to stand. That if it be cut off immediately after the injury is seen, the grain actually derives very considerable advantage from the sap contained in the straw.

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Bad cradlers, and bad reapers, destroy much grain: infinitely more, however, is lost by those who could perform either well, if harvest was not considered, as the holidays too generally are, a time for drinking to excess. This renders many incapable of doing any thing properly. Others, who are not quite so far gone, are disposed to run races a part of the day, and spend the rest of it in drinking under the shade, or in quarreling and fighting.

In fact, too many of the labouring part of the community are, at this season of the year, more like drunken savages than members of a civilized community. This evil does not spring either from benevolence or hospitality in their employers. Avarice seems to have been the first moving cause of this enormity. In direct opposition to the laws of God and the reason of man, this contemptible, selfish principle, induced many to outbid their neighbours by a more plentiful supply of ardent spirits.

If those farmers had known their own interest, or wished to promote the interest and rational happiness of those employed by them, or to act as men professing Christianity should, or, indeed, as an infidel would act, if he were not blinded by a false estimate of self interest, this shocking practice would not have been introduced.

Every farmer who wishes to promote the interest of agriculture, should set his face against it, and in lieu of whiskey, &c. pay an equivalent in money. I have never found it difficult to procure, either in the back-woods or elsewhere, as full a supply of workmen as my neighbours, who gave them as much ardent spirit as they would drink, although they got none of this from me. After the harvest was over, it was clearly seen, that the workmen were far better satisfied with receiving an equivalent in money, in place of injuring their health by drinking ardent spirits to the amount of it. It is not, however, in my practice only, that the beneficial effects of not allowing workmen either in harvest or at any other time, intoxicating liquors appear. There are many farmers in Pennsylvania, who would sooner suffer their grain to rot on the ground, than sanction this enormity.

Now, it is very observable, that these men never suffer by this arrangement; on the contrary, their fields are cleaner reaped, and with much less trouble and expense. Why then, is not this disgraceful practice, of injuring the morals, health, reputation, and circumstances of neighbours abandoned? especially, as in doing this, we also injure ourselves.

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CHAPTER XXIX.

On stubble crop grasses, and the management of them. On the properties of timothy, and on making it into hay. On the bad consequences arising from sowing too little grass seed. Observations on grazing and soiling; also, on the effects produced by the salivation, occasioned by second and third crop red clover, both in soiling and pasture. Remarks on orchard, and oat grasses.

I WILL now make some remarks on the few grasses which are best known to us, and most generally employed, and the proper management of them.

The stubble crop of red clover seldom grows high in cold climates; in those, it is best to let it rot on the soil; if grass be scarce, it may be pastured, provided a good covering of the tops be preserved; even in the lower latitudes, the value of this crop is inconsiderable; if used for grazing, or hay, the cattle are salivated. The wounds inflicted on the plants, by gathering the crops on which the seed was sown, turns a considerable proportion of the grass dark coloured, and renders it putrid. This, with the stubble cut off with it, often reduces the value of the hay so much, that it appears better calculated to injure, than support cattle.

When it, however, grows so luxuriant, that there is danger of the plants falling, and, together with the stubble, forming a close mat, which will greatly injure, or destroy their roots, it should be mowed; in that case, it will furnish valuable litter, or if better hay cannot be had, it may be given to the cattle.

If oat grass be excepted, stubble crops of the speargrasses, sown in the spring, seldom grow high enough to fall, and injure the roots of the plants. Unless dry fodder or pasture be scarce, it is best to let them grow, and rot on the soil: they, however, furnish much better hay or pasture, than stubble clover. If pastured, the cattle should not be admitted, until the plants have attained sufficient size, to keep them from being pulled up by the roots, and a good covering of their tops should be preserved.

Timothy makes very valuable, and beautiful hay; it will be tolerably good, even when suffered to stand, until it is nearly cured, before it is cut; this makes it very valuable, in the back-woods, where labour is scarce, and the farmer is sometimes compelled to defer mowing too long.

Mr. Bordley, and some other gentlemen say, timothy furnishes the best hay, when mowed after harvest, but this practice seems at least doubtful; while timothy, and many other plants, are forming their seed, the leaves commence falling off; therefore if it be suffered to stand, until its seed be perfected, little, except dried stalks

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is left to be mowed. This is seen in wheat, the straw cures and turns yellow, as the leaves fall, to let in the sun, to perfect the seed.

Timothy yields much seed, and no question but this is stored with nutritious matters; it would, however, seem, that it is too small to be generally masticated, either by cattle or horses; this may be readily seen, as it grows plentifully, when dung is dropped by them, in situations favourable to the germination of it.

Timothy, and every other grass with which I am acquainted, yields the most, and best hay, when cut in blossom. At that time, the leaves have attained their full size, and continue fast on the stalk. The rich matters which form the seed, still remain in the stems, leaves, and flowers of the plant.

If securing the leaves, flowers, and rich juices of other plants, greatly adds to the value of the hay, it does not seem reasonable to believe, that timothy forms better hay, after it has been stripped of these valuable properties: especially, as no better reason for recommending it, has yet been given, than that horses prefer this weather-beaten hay; for there are farmers, who say timothy hay is better, when mow burnt, and assign the same reasons to prove this imaginary fact.

The true state of the case, seems to be simply this, timothy is such an excellent grass, that after injudicious management, or any other cause has injured the hay very much, it still retains considerable value.

If the economy of this very valuable plant, had been investigated by the gentlemen who recommend late mowing, they might have seen, that nature seems to determine the time of cutting it. When it is in full bloom, the shoots which form the second crop, are vigorously springing around the sides of the bulbs, that formed the stems for the first crop.

But one bulb, and one stem, seems to be at first formed by each seed; the shoots from this, form other bulbs, and each bulb forms its own fibrous roots.

Nature has wisely ordered, that the grasses which are so often cropped, should generally propagate from their roots, as well as seeds: this encourages too many American farmers, to pursue the mistaken economy of sowing by far too little seed, and depend on the natural spread of the grasses to cover the soil; they, however, often suffer more from this inconsiderate practice, than ten times the value of seed saved by it.

Until the soil gets tolerably well covered with the grasses, the crops will be light. Before this happens from a natural spread of them, it too generally occurs, that hardy weeds take possession of the vacant ground between the plants. Thin seeding causes the speargrasses to form tussocks, growing high above the surface of the soil. The consequence is highly tedious and wasteful mowing of scanty crops, rendered still less valuable by the multiplicity of weeds mixed with them.

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This is but a part of the evil occasioned by the deficiency of seed. When the grounds are broken up for crops, the tussocks cause tedious and bad ploughing. It being very difficult to turn them well under the soil, they are commonly dragged about by the harrow. If small grain be sown, they are dragged up into heaps with the seed, throughout the whole field, to the great injury of the crop.

Even a naked fallow, well cultivated, is not sufficient to reduce those matted bundles of roots, unless more manual labour be expended on them than the farmers in this country, are generally disposed to bestow.

If fallow crops be planted, these bundles are pushed or dragged about on the surface of the soil, until the riches contained in them are scattered in the air, unless a wet season, or an adhesive soil keep the grasses and weeds alive. In that case, they prove very injurious to the present and future crops. No men, however, complain louder against tussocks, than those who have introduced them, by a bad system of management. If seed enough be sown on a soil well prepared, and it prosper, tussocks are never formed.

Timothy springs and ripens late. It seldom yields a second crop, worth mowing, except in moist bottoms or uplands highly enriched. It is hardy, and continues growing, until vegetation is locked up by frost. The second crop, however, progresses so slowly, that it cannot be justly considered extensively useful for grazing, unless it possesses very superior properties for fattening cattle. Still this grass will be found very profitable for soiling, as the first crop comes on later than that of any grass in general use among us, which is equally valuable. It is also abundant, when the soil is good, and likewise capable of standing longer, and after it is fit to cut, with less injury than many other valuable grasses.

First crop grasses are vastly more nutritive than the second crop. Therefore, the fattening of cattle in the yard will be greatly hastened by reserving timothy to be cut for them. An abundant supply of it will bring the most forward cattle to an early market. This generally enables the farmer to command the highest price given for cattle fattened on grass.

The same effects seem to be produced by reserving the first crop grasses for grazing. We may reasonably suppose, that whether the graziers in this country are, or are not governed by the theory advanced by me, they must have seen that their cattle fattened better when kept in pastures, which were sufficiently luxuriant to bear mowing after them, or they would not have adopted the practice, which in any other point of view, must be considered very wasteful. A full bite (as some term it,) is necessary to facilitate the fattening of cattle, especially if they be large: still, a great excess cannot be useful, except to preserve a supply of more nutritious food than is found in the second crop grasses. The cattle are compelled, in gathering the young and tender sheets of the second crop, to gather more or less of the older or more nutritive grasses with them. It may also be, that finding the poison contained in the tender

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shoots of some of the second crop grasses, sicken them, they have the sagacity to prefer, and select enough of the older ones to correct this injurious effect.

Certain it is that when the second crop grasses, given to my cattle in the yard, consisted of red clover, I have seen them prefer eating the old straw, with which their sheds were thatched. Nay, more, I have seen them (though naturally quiet,) so much goaded by hunger, that they have broken the fence of my cattle yard several times in the course of one day, when a plentiful supply of fresh cut, beautiful looking, second crop red clover was entirely rejected by them, and which no efforts of mine could compel them to eat.

What may appear still more extraordinary, I have seen them, after being turned into the very fields from which this second crop clover had been cut, return in the evening tolerably well filled. Whether they have sufficient sagacity to pick out the least obnoxious parts of the clover, or to gather other plants that are in some certain degree calculated to counteract the baneful effects produced by the clover, is unknown to me. The facts are, however, correctly related.

I formerly believed the salivation of horses and cattle, is not altogether confined to red clover. I had observed, that in proportion as this grass predominated, in loads procured from a mixture of it with the speargrasses, my cattle confined in the yard were more or less salivated.

Since I have removed to the back-woods, where red clover is too seldom sown, I find the horses and cattle slabber quite as much as they do where this grass greatly prevailed. My neighbours say white clover is the cause of this. It may be, and I suspect it is, the principal cause: but until the cattle be confined where they can get no other grass but white clover, nothing certain can be known of the extent of slabbering produced by eating it.

The speargrasses grown on the farm, where soiling was extensively practised by me, consisted principally of timothy, orchard, and green grasses, with some little oat grass. It clearly appeared, that if these grasses be in any degree affected by the cause which produces salivation, it can be but little, as the second crops were found capable of greatly correcting the profuse slabbering certainly introduced in my practice by red clover. These grasses, when mixed with the clover, never failed to effect this valuable purpose, and that too, as far as this could be determined by the eye, in due proportion to the quantity of them which happened to be mixed with the clover, brought in with them for feeding the cattle and horses in the yards.

If the cause of this disease were known, we might still more certainly distinguish the grasses which are not subject to it. If found valuable they might be cultivated.

If my memory be correct, we are informed that gypsum may be profitably applied as manure for lucerne. If so, and the plant be

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not affected by the cause which produces salivation, it will be an excellent substitute for red clover.

The roots of this grass are hardy. There can, however, be no doubt but the superficial cultivation recommended in my book on that subject, will effectually prepare a lay formed of it, with but little labour, if the sod be well turned.

If what Robert R. Livingston, Esq. who was practically and well acquainted with lucerne, says of the properties of it, be correct, and I believe he has not overrated them, it will be found at least equal to red clover, when sown broad cast, for all the purposes for which the latter plant is employed; especially, if enough of seed be sown. It would also appear, that lucerne may be profitably grown on any soil which is not hostile to red clover. That is, if what different gentlemen have said of the different soils in which it prospered, in their practice, be correct.

The cause of salivation has been too long sought in the different weeds which spring up among clover, in various soils. I have, however, been in the habit of sowing the seed of this plant plentifully. The clover, of consequence, stood thick on the ground. This introduced much shade, which, together with the frequent use of the scythe, had so far destroyed weeds, that in some places, few, if any, were to be found: still, the second and third crop clover mowed from those places, were equally injurious to the cattle and horses.

Most of the diseases to which vegetation is subject, seem to originate from insects. It is by no means improbable that the malady in red clover is occasioned by them: also, that if the second crop were properly and carefully examined, through the different stages of its growth, the cause would be seen. This might lead to the best means of preventing, or counteracting, the evil arising from it.

This disease is checked by the first white frost that is seen to cover the grasses, in the fall. If the frosts succeed each other tolerably quick, it, with the Hessian fly, and all other flies, disappear. I have seen a heavy white frost put an immediate stop to every appearance of salivation among horses and cattle. When this, however, was not followed by other frosts, slabbering soon recommenced, and continued until it was again checked by the same cause. May we not infer, from this, that if the farmer deferred cutting his second crop clover, until frost checked the slabbering among his cattle, that all the grass mowed until salivation again commenced, would make valuable hay. Until now, however, I have never thought of this, although I have often observed that cattle and horses grazed on second crop clover, gathered flesh as fast as on any other second crop grass, after white frost put a stop to salivation.

Horses and cattle gather but little flesh when grazed on red clover, during the season for salivation. Cows immediately fail in their milk. The butter made while slabbering continues is gene-

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rally bad, and some cattle and horses fall away greatly even in luxuriant pastures of this grass.

I ought to have observed before, that when timothy is sown on small grain, in the fall, if it be done early, the plants head among the grain, and greatly injure the crop; if late, the young and tender roots of the plants are often thrown out by frost.

This, and every other grass with which I am acquainted, is best sown on spring grain, early in the season. It, however, and red clover, prosper well when sown on fall grain, early in the spring, or in February, as may best suit the climate. The freezing nights and thawing days, at this season of the year, cover the seed, and prepare the soil for the more ready admission of the roots of the plants. The farmer, however, should remember, that not less than one peck to the acre of these seeds should be sown.*

Some sow grass seed on the snow, as in this way they can better see how it is done. The practice is a bad one. If the snow melts suddenly, the grass seed is swept away by the water arising from it.

Oat grass grows from five to six feet high. It is the earliest, latest, and most productive grass known to me. If it be, as Dr. Muhlenburg represents it, "the best grass for green fodder and hay," it must be very valuable. The leaves are broad and extensive. On my farm, in such parts of the soil as were good, every crop produced a flowering stem. This seems to increase the value of the second, third, and fourth crops, for hay or soiling. It grew much faster and higher than any other grass on my farm. It may be cut oftener than any other grass that I have seen. As the crops are, also, more abundant, it must be very valuable, if its fattening properties be equal to its product.

My acquaintance with this grass has been very limited; but it so happened that a part of the grounds first sown with it by me, was very stiff, retentive clay, and another part quite loose, sandy, and dry. It grew luxuriantly on both. A scarcity of speargrasses induced me to cut the stubble crop of this patch for soiling my cattle and horses. It was freely eaten by them, and, as it grows very rapidly, the grounds produced another crop the same fall, which was applied in the same way.

Nothing but necessity should induce cutting stubble crops for soiling. Cattle, either from their previous habit, or some other cause, appear to be incapable of selecting their food, when given to them in a compact mass. In this case, they are compelled either to reject the grass, or eat a very considerable proportion of the stubble and weeds contained in it. Stubble grasses, however, may be fed to young cattle in a separate yard, when better grass is scarce.

* Also, that the clover plant is much tenderer than timothy, and most other speargrasses; consequently, the seed should be later sown. Still, not so late as to prevent the frosts from covering it, and preparing the soil for the more ready admission of the roots of the plants.

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The patch of oat grass mentioned above, was mowed the ensuing year for hay. But it so happened that it was not done until the seed was ripe. This, with some dripping weather while the hay was curing, caused it to look more like straw than hay. I believe it should be mowed as soon as the blossoms appear. The seed shatters out very soon after it is fit to gather: therefore, if great care be not taken to reap the plants in time, and to handle them very cautiously in the reaping, gathering, &c. little or no seed will be saved.

The seed is very light and chaffy, consequently seems to be easily injured in the process of gathering and saving it. The little sown by me vegetated badly. It was sown at the rate of three bushels to the acre, and carefully harrowed in by a light harrow after sowing barley, for which the grounds had been well prepared. The same happened when sown in the spring on winter grain. The seed of it and orchard grass seem too light and chaffy to be successfully sown on winter grain in the spring. They appear to lie on the surface like chaff, and too much of it is either blown away by the wind or rots on the ground. This, however, might not happen if the seed was fully formed before it was gathered.*

I am doubtful whether oat grass is capable of furnishing either green fodder or hay equally as nutritious as timothy or orchard grass. Its stems are very hollow. The hollows in the stems of timothy are small. Scarcely any hollow appears in those of orchard grass: still, as the oat grass exceeds either of the last mentioned grasses in quantity, and every crop produces flowering stems, when the soil is rich, also springs earlier and grows faster even than orchard grass, it may be found very valuable for pasture, soiling and hay; therefore it should be carefully cultivated on a small scale until its fattening properties are better understood. As the seed of it is large, light and chaffy, it would seem that less than three bushels to the acre should not be sown, even when the seed is good.

Orchard grass is very valuable. It springs very early. When cut off by the scythe, it neither waits for fresh shoots from its roots, nor until its wounds be healed, but continues growing on just as if nothing had happened. The leaves which have been cut will grow, on a rich soil, nearly, if not quite, one inch in the course of twenty-four hours, forming new points gradually as they increase in length.

It is very observable, when it has been sown with red clover, and both cut off by the scythe at the same time, that it greatly outstrips the clover when cool weather commences in the fall, and soon becomes much taller than it. The stalk of orchard grass is very solid, grows high, and the leaves are abundant; therefore the first crop of it will greatly exceed that of timothy. As horses and cattle

* As orchard and oat grass seed shatter out soon after ripe, this may have induced those who gather these seeds for sale, to do it before the structure of them have been sufficiently formed to vegetate well.

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eat the hay freely, and thrive well on it, I am compelled to believe it must be a much more profitable grass for this purpose. As it blossoms with red clover, and should be cut at the same time for hay, and will (except in high latitudes) produce a good first, second and third crop for mowing, if the soil be good, it must be greatly preferable to timothy, either for soiling, grazing, or hay, unless it should hereafter be found, that it is greatly inferior to that grass in nutritive properties. No information or observation, however, has occurred, since my acquaintance with both these grasses, which would justify this opinion. On the contrary, it would appear, that orchard grass is as nutritive as any of the grasses generally used by us, and that it may be more profitably employed either for hay, pasture, or grazing, than any of them.

Notwithstanding the great value of orchard grass, it will be found much the best practice to cultivate no more of it for hay than can be cut and secured in proper time. Though it will stand without apparent injury some time after it be fit to cut, it is greatly injured if mowing be deferred for a considerable time after it is in full bloom.

The seed of this grass is light and chaffy, shatters out greatly, unless the plants be cut in time, and very carefully handled. It would seem that the seed is often damaged. I have sown three bushels of it to the acre without obtaining any thing like a sufficiency of plants. As it is much smaller than oat grass seed, it would seem, that one bushel of it ought to be enough for an acre of ground, if the seed was sowed without being injured.

The plant yields an abundance of seed: therefore, saving a plentiful supply of it will not cost the farmer much labour if he be careful in the gathering and saving of it.

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CHAPTER XXX.

Observations on green grass. Further remarks on grazing; also, on orchard grass and red clover. On haymaking.

GREEN grass will neither vegetate, nor grow in a poor soil; the seed lies torpid, until the soil happens to be enriched; it then proves itself to be a hardy native; where the soil is only tolerably good, it will root out, not only the foreign grasses, but alsoa lmost every inferior native grass.

In this way, our fields of green grass are procured, but it progresses slowly, in covering the soil, if it be not rich. As farmers generally give but too little attention to manuring their grounds, it commonly happens, before this valuable grass spreads itself well over them, that poverty, aided by time, and the hoofs of the cattle, consolidates the soil, and the grass crops are light. When the soil is naturally rich, or has been highly manured, it will spread more rapidly, and the crops are very valuable, either for hay, grazing, or soiling; unless, however, the whole of the produce be consumed by cattle, which continue on the grounds at night, as well as in the day, and the dung from them be carefully spread abroad over the soil, poverty, with the aid of time, and the hoofs of the cattle, will consolidate the soil so much, that vegetation will languish. When this happens, and the owner is determined on grazing, he may open the soil, by a covering of enriching manure; if this be scarce, it may be opened, by suffering a good second crop of grass to grow, and cover the grounds closely, through the fall and winter. The final decay of it will also enrich the ground considerably; but if the soil be too thin to produce a good second crop, the whole of the grass grown through the season, should be suffered to remain, and rot on the ground.*

Perhaps, a partial relief may be obtained, by Mr. West's plan, of sowing red clover seed, over the green grass, when the soil becomes consolidated. The introduction of this plant, however, in grazing grounds, should be avoided; it will certainly poison the cattle, more or less, during the season of salivation; but few of them will gather flesh, and some will fall off, until frost has checked, or destroyed the cause, which produces this injurious effect.

It is useless to commence grazing on a thin soil, without the aid of the plough, or extraneous manure. After the grazier has, by either of these modes, or both united, enriched his grounds: if he be determined on grazing exclusively; it will be found best, not to introduce any plant which is known to acquire, and communicate, the poison that salivates horses and cattle. It is probable, that no

* See note at the end of this chapter, page 305, 306.

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plant in general use among us, will answer his purpose so well, for laying down his grounds in grass, as orchard grass; it not only possesses the properties which have been described, but it is also so hard to be rooted out, that I have seen it growing more luxuriantly, after an inefficient cultivation of the soil, than it did before this cultivation took place. Nay more, I have seen it growing among green grass, without any appearance of its being rooted out, even by this very hardy native.

It, however, seems probable, that green grass will eventually root it out, if so, the grounds will be sooner or later covered by the former; it being very hardy, and springing very early, and continuing to grow, until vegetation is hard bound up by frost, it is the next plant to orchard grass, in value for grazing, and will continue for ever, if the soil be kept rich. The grazier must expect, however, to be continually pestered with weeds, still much more hardy than green grass: also, that his grounds will not yield him any thing like as much valuable vegetation, as if they were subjected to a regular, convertible husbandry.

Green grass can never be very valuable to the farmer, in the way it is commonly obtained; this being from a natural, and too frequently from a very slow spread of it, over his grounds, as the red clover plant may happen to run out. The result of this practice is, commonly, thin, light crops, until the soil becomes sufficiently covered by the green grass; before this occurs, it often happens, that the grounds become too much exhausted, to produce valuable crops of this grass.

When this takes place, many farmers say, the soil is hidebound, without appearing even to suspect, that it may also be poverty bound; the lay, of consequence, is ploughed up, and subjected to such a course of crops, as may chance to be fashionable in his neighbourhood; if he be, what some call a good farmer, the grounds after an impoverishing course of cultivated crops, are sown with red clover; this is manured by gypsum, and as a very reduced portion of the enriching matters, introduced by the roots of the grasses still remains, he obtains a profitable crop of red clover: of consequence, highly values the great improvement, introduced by this supposed ameliorating system of husbandry. He is therefore encouraged to go on with it, until the soil becomes too much exhausted for even the wonder working powers of gypsum to act profitably: thus, finding himself disappointed in his irrational expectation, he is very apt to believe, with too many more, who have also used this invaluable substance very improperly, that the evil introduced by his own folly has been done by the gypsum.

The stem of green grass is as solid as that of timothy, and the hay seems to be equally good. It is, however, a small plant when compared with either of the grasses mentioned above. The size of it would be considerably increased by sowing the seed on the grounds properly prepared: yet even this could not induce it to produce any thing like as much vegetation as oat or orchard grass. No

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question but the first crop of timothy would also exceed that of the green grass considerably. As, however, the aftergrowth of the latter would exceed that of the former, this would make up the deficiency, unless dry weather ensued after the first cutting; for in that case, both of these grasses suffer exceedingly.

This should highly recommend orchard grass to the particular attention of farmers. I have not only seen it green, but also progressing in growth, while green grass and timothy were parched up by drought; and there seems to be no doubt but it is equally as nutritious as either of them, for grazing or soiling. It should, however, be recollected, that the nutritive properties of food, is a difficult question. Unless the cattle be regularly and very carefully fed on each in due succession, and their gain or loss determined by weighing them, but little can be correctly known of this very interesting subject. Much will also depend on whether the grasses, at the time the experiment is made, are in those stages of their growth, which will be alike favourable to the nutritive matters each of them is capable of affording. There is certainly much less nutritive matter in grass when it is young, than when it is older; there is also a great difference, in this respect, between first and second crop grasses.

Notwithstanding the second crop of red clover salivates horses and cattle, under this very apparent disadvantage it may be justly considered exceedingly valuable. Not less, however, than one peck of the seed of this grass should be sown to the acre. When a sufficiency of seed is sown, more grass is obtained. The stem is smaller, and more freely eaten by cattle, either in pasture, soiling, or hay. The hay is sooner cured. The cocks formed of it do not let in near so much rain as when the stems of the grass are very large. The lay is enriched by the increased number of the roots for the growth of the cultivated crops following this grass. The weeds are smothered by the close shade of the plants, when a sufficiency of seed is sown; and the rich depositions from the atmosphere are also far better secured, as the injurious effects of the sun and air are excluded.

This is not only applicable to clover, for the same advantages are to be derived from sowing a sufficiency of any kind of grass seed in due proportion to the different properties of the plants. The stem of red clover is very solid and succulent. The first crop is not only abundant, but also excellent, either for hay, soiling, or grazing. There is no grass, in common use with us, which seems to be so valuable for hogs.

Some assert that horses are injured from being kept on this hay. No question but this has often happened, and to a very serious and sometimes fatal extent, when luxuriant crops of this grass have been suffered to stand until they become slimy and mouldy in the bottom; or when the hay has been injured in the curing; or put into mow, or stack, before it had been sufficiently cured.

The latter practice has done incredible damage. Though some gentlemen may have succeeded in curing it, in this way, so far as to imagine the hay was greatly improved by that practice, this does

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not establish the fact, for many of them have also believed, and asserted, that timothy hay is much better when the plants are suffered to stand so long, that but little except dried stalks are gathered. Others, that it is more valuable, when burned in the mow.

There is still a much better reason to believe that those advocates for inning clover hay, before it would have been formerly considered half cured, are egregiously mistaken. Previously to the introduction of that very irrational practice, we seldom heard of horses injured by being kept on it. When we did hear of this evil, it was attributed to the real cause; to wit, to the hay being injured.

It is really wonderful that gentlemen of talents, and accustomed to reflect, should select this plant, in preference to all others, to be cured in the mow. Its large, solid, and very succulent stem, renders it much more subject to damage from being put up too green, than most other grasses in use with us. This assertion is not founded on theory, for I have extensively cured clover and all my other grasses in swath. Clover hay has also been too often put into mow and stack by me before it was sufficiently cured with or without salt. I have also observed the effects produced by this practice, when it was pursued by others.

It generally causes the hay to become more burned, and sometimes injures it so much that it would be the most economical practice to use it for litter, and buy better, rather than risk suffering the injury, too often introduced, by feeding it to domesticated animals. Instead of saving the rich juices of the hay by this very inconsiderate practice, they are compelled to undergo a process that actually destroys the greater part of them, and are but too often converted into a slow, and sometimes a deadly poison.

The reason given for this practice, is, that the rich juices and leaves of the plants are better preserved. It should, however, be recollected, that the water, which forms a large portion of the clover and other plants, forms no part of the rich matters or juices, notwithstanding it may be mixed with them; and that, from its properties, it is calculated to escape first. Also, that when this fluid has been sufficiently evaporated, the hay should be inned.

If the plants be mowed so soon as they are in full bloom their leaves will be found closely adhering to their stems. When the blossoms begin to fade, nature weakens the grasp of the leaves, that they may gradually fall off, and let in the sun and air to perfect the seed: consequently, even those leaves which may be found on the plants when they are late mowed are much more liable to fall off during the making and inning of the hay.

Perhaps this may be better understood by remarking, that, if a tree be cut down, or girdled, some time previously to that period at which nature has determined to loosen the grasp of the leaves, so that they may fall, the leaves on the tree which has been girdled or cut down, wither, but continue so firmly fixed to the branches and twigs that they are not readily removed by time. They retain

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their natural position a long while after the fall of the leaves from trees of the same description.

Notwithstanding these very obvious facts, many farmers will not mow the red clover plant until the blossoms generally fade; and by far too many, not until the seed is fully formed. Some say that the quality of the hay is injured; others, that the plants shrink, and the quality and quantity are both reduced by mowing early. If either happens, I have not observed it. I have, however, seen, that after the flowers begin to fade the plants seem to loose far more at the bottom than they gain at their tops: also, that if mowing be deferred until the plants become quite old the hay will salivate horses. As this happened but once with me, the cause was not investigated. It was supposed to originate from the second crop growing from the roots of the plants to a sufficient size, before the first crop was mowed, to become affected with the poison that produces slabbering.

I did not like to abandon the practice of curing hay in the swath, having observed that it saved labour. The grasses are at all times very expeditiously turned in the swath. If continued rains occur, the swaths are not only quickly turned, but if the sun shines powerfully between the showers, the inside of them is not scorched by its rays. By turning the swaths, throughout long continued rain, so often as the underside of them was likely to be injured by fermentation, I have saved extensive fields of hay, while my neighbours, who gave no attention to this interesting subject, had their crops entirely ruined. If the grasses, however, be raked up into small winrows, they are as readily turned, and may be as effectually preserved, as if they remained in swath, but in this case the labour is greater.

Curing hay in swath, to save the juices, seems to be not only practically wrong, but also opposed to reason. The confined heat and moisture in the interior of the swath promote fermentation: this must be more or less injurious to the nutritive matters contained in the grasses. It is exactly calculated to weaken the grasp of the leaves, and separate them from the stalk. It also greatly weakens their general texture, and causes them to crumble into pieces when they become dry. While this is doing, the outside surface of the swath is scorched by the rays of the sun, and becomes but little better than straw, before the inside is moderately cured. In raking, cocking, heaping and inning, the swaths are so far separated that many of the leaves are lost before the hay gets into the mow: but few of them get into the rack. This is best seen when barns are constructed on the side of a hill, and the cattle and horses stabled and fed in the lower story. In that case the hay is first pitched from the mow into the threshing floor, from thence it is pitched through the trap-doorway into the passage formed below for distributing the hay into the racks.

Now, the quantity of leaves which are gathered together by this simple process, both in the threshing floor and feeding passage, is

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so amazingly great when their texture has been injured by excessive heat, or fermentation, that it would far exceed credibility with those who have not given due attention to this interesting fact. This is not all: the imperfectly cured part of the hay in the middle of the swaths too often creates an immoderate heat, and causes the whole mass to become either dusty, mouldy, or mow burned.

The good old way of shaking out the swaths, and spreading them carefully over the whole surface of the soil, as fast as the grasses are mowed, will, in this instance at least, be found much the best. The old practice should, however, be stripped of the very expensive, and, but too frequently, exceedingly injurious labour employed in it of turning and cocking the grasses by far too often. This can do no possible good, and, but too generally, causes a great loss of the leaves and nutritious juices, by drying the hay too much. Still, when the crop of hay is so luxuriant as to cover the surface of the soil very deeply, it must, of consequence, be more frequently turned; especially, until the leaves get properly withered.

Winrows, in the evening, will be found sufficient, until the hay is more than half cured. After this it demands the farmer's most serious attention, as it is liable to great injury from wet, and is frequently not only greatly injured, but also ruined, by rain: therefore, in this stage of the process, the cultivator should not leave the field in the evening, or when rain is expected, before he has effectually secured the whole in high,* sharp topped, and well formed cocks, smoothly raked down, and the bottoms of them well tucked under: especial care should be taken to cover the tops of the cocks with that part of the hay best calculated to form a kind of thatch over them. The cocks should be placed on such spots as are best calculated to prevent water from running under and wetting the bottom of them. Unless the hay be fit to put into the mow, it should be spread out the ensuing morning, if the weather permit, around the spot where the cock stands, in that way best calculated to cure, and, at the same time, to abridge the labour of putting it up into heaps, for hauling in, or in cock, in the evening, if it should not be sufficiently cured. After the cocks have been spread open, the hay should be turned and shook up, so as to admit the air and sun, as often through the day as the case may seem to require.

It is impossible to say how long it will take to cure hay in this way. This can only be determined by the succulence and size of the grasses and crops, and weather that may chance to occur. In general, however, the process is short, and far from being laborious, if the grass be well spread and lightly shook out, as fast as it is mowed, and so managed as to cause it to become generally withered as soon as this can be effected. On this very simple, but at the same time, powerful and interesting part of the process, very much

* If cocks be not made high in proportion to their width, they become too flat, after they have settled, to turn off rain.

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depends. It is the first, and, if well managed, the principal step to be taken to save the hay, not only from the great injury arising from fermentation, but also from the risk naturally arising from its lying out much longer, when cured in swath: or the still much greater risk which arises from the injudicious practice of putting it into mow or stack before it is sufficiently cured.

The leaves of the hay which has been spread out immediately after the mowers, and turned and shook open as soon as it ought to be done, become tough by withering in the open air, as do the leaves on the tree that has been girdled, or cut down, before nature had loosened their grasp. They will, also, like those leaves, maintain their strength, unless the hay be dried too much. Even in that case, they are far less subject to fall off, or crumble to pieces, than they would be if the grasses were not cut until after nature had commenced loosening the grasp of their leaves; or if, after they had been cut, fermentation had loosened their grasp, and, also, greatly injured the texture of them. The withering of the outside of the swath hastens the flexibility within it. This soon forms a mass sufficiently compact to produce as much heat and fermentation as will loosen the grasp of the leaves, and greatly weaken the general texture of them.

It is true, that if the weather should chance to be too long wet, the hay will heat and ferment in the cocks. But this is unavoidable in any mode of management: therefore, the injury done in this way will frequently occur, unless it should hereafter be discovered that measures may be taken which will prevent it.

When long continued rain occurs, hay may be cured principally by the heat originating in the cock; and, as I believe, better, and with less labour than in any other way that has been yet proposed, to prevent very material injury, when the season happens to be dripping.

I formerly cut and cured much third crop hay. It so happened once, that after the melting of a fall of snow, about six inches deep, I cut and cured a small field of grass. The weight of the snow had laid it very near to the ground. This, however, did not seem greatly to impede the mowing. The mower was expert, and careful to change his position so as best to suit the different directions in which the grass happened to be laid.

This, and other circumstances, induce me to believe that second or third crop hardy grasses may be profitably reserved through the winter, to be cut early in the spring for feeding cattle in the yard: especially where snow would greatly preserve the grasses from injury throughout the winter.

Frequent rainy, cloudy weather, with short days and a distant sun, often make it necessary to cure the grasses mowed late in the fall principally by heat in the cock.

In my practice, the grass, so soon as it became generally withered, was put up in high, well formed cocks. Heat soon expelled a part of the moisture from the interior of the plants. Much of this,

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of consequence, lodged in the cock. When the weather was such as to dry the outsides of the cocks, they were opened and spread out, but no further from where the cock stood than seemed absolutely necessary. This, with turning and shaking up the grasses, caused the moisture which had been lodged in the cock to evaporate. If the day chanced to favour the process, some of the moisture still remaining in the interior of the plants, also escaped.

In the evening the grass was again put up into cock, and the management above described pursued, until it was sufficiently cured to be put into mow; except that, in proportion as the hay cured, the size of the cocks were doubled, by putting two of them into one, until they became very large.

In one instance, however, so much cloudy, cool, dripping weather prevailed, that the grass never became sufficiently wilted or dry to be put up into cock. The whole of it was eventually so much injured, that it was hauled into the cattle yard for litter.

Whenever it can be accomplished, hay should never heat except in stack or mow, and no more there than is absolutely necessary to settle it into a tolerably compact mass.

When hay is put too green in the mow, an immoderate heat ensues. Water being a subtile fluid, makes its escape. This intense heat, however, also expels the rich juices from the interior of the plants. Little of them seems to escape; but it would appear that they are decomposed and dried in the oven which folly has heated; and if the barn be not set on fire, by this inconsiderate project, become very injurious, and sometimes a deadly poison to cattle and horses.

If the multiplied herbs gathered for culinary and medicinal purposes, and the immense quantities of tea brought from China, were put up in heaps or boxes, previously to their being half cured for the express purpose of saving the valuable juices contained in them, we should soon smell and taste, and, if compelled to use them, severely feel, and loudly complain against, the evils introduced by that irrational practice.

Horses and cattle smell and taste, at least as accurately as men; they also feel as severely the consequence of being compelled to live on unwholesome food, stripped of its nutritive properties. They cannot, however, tell us of this: therefore, things must remain as they are until men are convinced, that no practice should be repugnant to nature, reason, and common sense.

Red clover produces a large second crop, and if the soil be good, and the climate not too backward, the third crop is far from being inconsiderable. Farmers gather their seed from the second crop; it, and also the third crop, would be very valuable for hay soiling, or grazing, if it did not salivate the cattle.

The slabbering is but trivial, if the hay of the first crop be fed during the night, and that of the second or third crop, through the day: still, it seems doubtful, whether much is gained by the second and third crop, even when they are fed in this way: as both

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horses and cattle will slabber some, and must be more or less sickened by it, they may lose nearly as much as they gain from this unwholesome food.

These crops certainly do more injury than good, when used for soiling. If they be grazed, cows fail greatly in their milk, and, though cattle may be kept in pasture on this grass, it cannot be depended on to fatten them generally, until after frost has checked it, or put a stop to salivation.

Many things have been proposed, to counteract the salivation, but I believe the whole have failed. Ingenious, and skilful men, however, should continue to make experiments. It may be, that some mode of curing the hay, or some substance strewed among it, while putting it into the mow, might destroy, or correct the poison. Be this as it may, the subject is interesting, and worthy of much attention. No grass known to us, seems to be so well calculated to form a lay for small grain. I believe it would greatly puzzle the most ingenious farmer, to enrich a poor soil in this country, speedily, and profitably, without the aid of this invaluable plant, unless as valuable crops of lucerne may be as readily excited by gypsum, as of it. The second and third crops of red clover, will, however, be found profitable for pasture, and perhaps for hay, after white frost has checked, or put a stop to salivation. No question, but they will also be found exceedingly valuable, when ploughed under, or suffered to rot on the soil.

Still, I would advise the farmer, who has enriched his grounds sufficiently, and possesses the certain means of keeping them so, to banish this plant. The poisonous properties of all, but the first crops, will cause it to be a very obnoxious weed to him, which he can very readily do without.

Notwithstanding I have very pointedly advised him to apply the worst of weeds, which may chance to grow on his grounds, to every possible advantage, I do not wish to favour the growth, even of the very best of them, when the soil may be covered by vegetation, which will be far more useful to him. He will, however, find it nearly as difficult to banish red clover, as the hardiest weed found in his grounds. It will be a work of time, as much of the seed is shattered by the plants on the ground, and a very great deal of it saved in the dung, whether the manure be, or be not used before it is decomposed.*

* An old acquaintance of mine in Maryland, manured a piece of ground which had been exhausted, and laid it down in timothy; he mowed the first crop annually, during nine years, without applying any manure, except that arising from the grass of the second crop, which he suffered annually to grow, and rot on the soil. The crops cut for hay were very abundant, and the last, quite as good as any of them. The seed grown, and scattered by the few weakly lateral shoots, which, by yielding to the stroke, escaped the scythe, kept the grounds well covered with this grass. The land lay high, and in that way, which seemed to favour but little, if any, advantage from the washings arising from grounds, which lay still higher than it. I can say nothing of what

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There are many other valuable grasses, some of which have been cultivated in this country; as I however know nothing of them, either from practice or observation, and wish to avoid subjects, resting on reading alone, unless, when the introduction of them, appears to be of considerable importance, I have said nothing of such grasses, except the observations made on lucerne.

happened in those grounds after the nine years had elapsed, as I have since heard nothing from them.

I have, however, since my removal to the back-woods, adopted the same practice, but without using dung, and commonly on exhausted grounds. So far, it seems to have succeeded, but best where clover was sown in place of timothy, on soils which had been previously exhausted. It has, however, so happened, that scattering plants of red clover, which originated from seed that had been formerly dropped by the cattle in their dung, come up with the timothy. The seed of these scattering plants, and that from their descendants, have been annually and very rapidly spreading the red clover over the grounds; as it prospers much better than timothy in a thin soil, it would seem from what has already occurred, that the latter grass will be rooted out, and red clover take possession of the soil; especially, as since gypsum has been used, the white clover appears to be giving way to the red; this seems to be the more probable, as all the seed from the second crop of red clover is perfected, and the wind, rain, and melting snows spread it over the soil, except that part of it which may be destroyed by the few cattle and horses, which necessity has hitherto obliged me sometimes to pasture on the ground. It would, however, appear, that as the cattle or horses are not turned in until the second crop of grass has nearly attained its full growth, and kept at night, as well as in the day, on the grounds, that the only, or principal injury done by them, is cropping off some of the heads of the clover plants, growing where the seed from them might have been profitably spread by nature over the soil. I do not, however, believe that grounds may be profitably mowed, if the second crop be pastured; the manure in this case dropped by the cattle, will be so thinly scattered, that many parts of the soil will receive no aid from it for a long time; it is, however otherwise, when the second crop is suffered to rot on the ground, as this is regularly spread over the whole surface of the field.

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CHAPTER XXXI.

On soiling, or feeding cattle in yards or stalls. Much injury is done by feeding second and third crop clover to cattle when confined in stables or yards. Various and highly important advantages are to be derived by feeding cattle on grass in yards. Soiling cannot be profitably practised on an extensive scale, unless the cattle be reared in the yard, or brought in while they are very young On cattle hoven by eating red clover, &c. On giving salt to cattle. On hogs and sheep. Every farmer should soil his working cattle and horses.

If I were to attempt to describe the great produce that might be obtained from reducing into one system of management, the improvements which have been already discovered in agriculture, it would exceed credibility. As these improvements have been only partially practised by different cultivators, and always more or less intermixed with very injurious practices, but little is known of the advantages that would arise from uniting them into one perfect system of husbandry. Therefore, on this very interesting subject but little has yet appeared.

My practice during five years, on the farm near Philadelphia, was, in theory, good, except that part of it which mutilated the roots of the plants, checked fermentation, wasted the farm yard manure, as well as that from the roots and tops of the grasses, and likewise formed ridges and gutters, exactly calculated to produce artificial droughts. These errors, however, together with that of generally crowding by far too many plants in the rows of my fallow crops, greatly curtailed the products of my soil.

My practice was also very much crippled, in consequence of being misled by those who wrote, in this country, on soiling: but most assuredly had never practised it, or they would have discovered that red clover, which they especially recommend for this purpose, was exactly calculated to defeat their intention, by convincing their pupils that soiling is impracticable in this country. I have reason to believe that this evil was effected, for though I have heard of many who attempted soiling, it appears that in every instance, it was quickly abandoned, from a clear conviction that it could not be profitably practised in this country.

Fallow crops, in the place of naked fallows, appear to be the leading improvement in husbandry. Even those, who say they will not answer but on a few soils, must allow, that if they could be generally practised, the produce would be vastly increased, and much labour saved.

If deep rooted prejudice in favour of perpetual meadows or grass grounds, did not prevent impartial reasoning on the merit due to

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that system of management, it would be clearly seen, that convertible husbandry would add greatly to the improvement made by fallow crops. This practice is most assuredly capable of introducing another very extensive addition to the products and improvement of the soil. To effect this fully, the whole of the grounds should be subjected to that system of management, excepting such only as cannot be ploughed, or are subject to be washed away by floods, and the grass lays, manure and cultivation, ordered in the way that has been pointed out in my book on Cultivation.

If this be done, and soiling be added to a well directed convertible husbandry, the practice of agriculture will be as perfect as our present knowledge of that art, and the instruments best calculated to execute the labour, will admit.

Soiling will not only save much more than half the grass, necessary for pasturing the stock, but it will also introduce a great additional quantity of manure. It is readily allowed, that notwithstanding cattle, while grazing, drop part of it where it does but little, and sometimes no good, that they also drop vastly more where it is very beneficially applied; and that notwithstanding a great part of the riches contained it is exhaled by the sun, scattered into the air, and washed away by the rains, the same happens to top dressings; and that too, very generally, after the manure has lost, by decomposition, a great proportion of its best properties, previously to the application of it.

Every practice should be allowed the full extent of the merit due to it; especially if we mean to prove it inferior to that recommended by us. It is, however, after this has been done, a notorious fact, that the manure gathered by soiling, is much more considerable, and vastly more extensively useful to the farmer, than that promiscuously dropped by cattle while grazing. He may secure it from any material waste, until wanted, and apply it in that way which will be most useful to him.

When soiling is practised, the grounds are not hard trod, and sunk into holes by the feet of the cattle. The working horses and cattle are always at hand. As they have not the trouble of gathering their food, they are quickly filled, and soon ready for business. When turned out to graze, it requires some considerable time to gather a sufficiency of the young and tender grasses, which they greatly prefer to the older, when grazing in the fields. From some cause unknown to me, they do not like the young and tender grasses, when mowed and fed to them in yards, even before salivation takes place. This has obliged me to defer cutting red clover for them in the spring, until it had attained a considerable size. I found, notwithstanding they had been previously confined entirely to dry fodder, that they greatly preferred it to clover, when grown only seven or eight inches high.

When live stock are confined in well fenced yards, the farmer may sleep quietly; his crops are not injured by their breaking into

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his fields. Division fences are saved; they are costly, and a nursery for weeds.

Cattle, when they are first turned in upon red clover, are often hoven. The fields are frequently distant, and the cattle dispersed over them; it is, therefore, troublesome to pay that attention the case requires, and many losses occur from this cause; they seem to be equally subject to this disease, when fed upon clover in the yard, but the necessary attention is readily given to them there.

The symptoms are restiveness, with an unnatural extension of their sides, belly and flanks; the upper part of their tail, is generally extended, as if in the act of straining to discharge wind; some paw with their feet, often lie down, but quickly rise up again.

My cattle were carefully watched, when red clover was first given to them: therefore nothing more was necessary, when the symptoms appeared, but to drive them up and down the lanes tolerably smartly; at the same time, taking care to avoid the injury which might arise from rapid motion. This soon caused them to discharge much wind; when their flanks became lank, the danger ceased for the present: care, however, was found necessary, as some of them would, immediately after they had been relieved, eat a sufficiency to produce the disease again.

It appeared in my practice, that the greater part of the cattle were not subject to the least injury, from feeding freely on red clover. That it is not the quantity, but the quality of the food, which produces the disease. No question, however, but an increased quantity, renders it much more dangerous. It would also seem, that but little, if any, serious injury would arise from this complaint, if proper care were taken, in the early stages of it.

Some of the cattle, subject to be affected by red clover, require great attention, for a considerable time; while others, equally affected in the beginning, soon become habituated to it.

That the quantity has only a secondary influence in this disease, was evident, for so soon as my cattle had discharged the wind, their flanks became lanker than they were previously to eating the clover; this could not have happened, if they had eaten very freely, previously to its being discovered that they were affected by the complaint.

I once had a pair of oxen hoven by the little clover they gathered while a carter was dropping out his loads of manure, into heaps, on a field, where this grass, mixed with timothy, was quite young and low.

Many cattle were killed in Maryland, while I lived there, by incautiously turning them into fields, to eat off the husks, which remained in the stalk, after the other fodder, and corn, had been gathered.

One of my neighbour's cows was, lately, very badly hoven, and seemed to be in very imminent danger; she was very quickly cured, by a drench of one pint of melted hog's lard: it is said, that a

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like quantity of sweet oil, or fresh butter melted, will answer the same purpose.

Some gentlemen assert, that an acre of grass has soiled from five to six head of cattle; there seems no reason to doubt but this may have happened, where the soil has been very rich, well set with grass, and the season favourable to the growth of every crop; I believe, however, that the advantages arising from this valuable practice have been too favourably represented, and that this has done vastly more harm than good.

New practitioners are discouraged, and often too hastily abandon a practice, when they find the advantages to be derived from it have been overrated: more especially, if difficulties are necessarily attached to it, which had not been previously explained to them; and which they had not been accustomed to encounter. This is not all, for when practice has been overrated, and its disadvantages not explained, those who are opposed to it readily refute a part, which, unquestionably, in common, more or less invalidates the whole.

My grass grounds, whether good, bad, or indifferent, were cut for my cattle, as either necessity urged, or prudence seemed to suggest; therefore, no experience of mine will admit me to state, correctly, the quantity of grass that may be saved by soiling; but it is certainly very great: still, as I do not wish to mislead, it is proper to observe, that after giving very much attention to this interesting subject, and attentively reviewing what happened in my practice, from the commencement of it, I am clearly convinced, that cattle which have not been early habituated to this mode of management, will not generally fatten so freely, or give as much milk, as they will do, when suffered to run at large, in good pastures: consequently, it would seem, that no farmer should enter extensively into this practice, unless he rears his cattle in the yard, or purchases them while they are very young.

It is by no means improbable, that rearing the cattle in the yard will be equally as advantagequs to the farmer as buying them of the drover, who purchases them of the back-woods cultivators, at low rates. Calves, while young, take too much exercise in pasture to fatten freely, or grow so fast, as when confined.* It also would seem that the nutritive properties of the older grasses will hasten their growth, and a ready access to shelter from sun and rain will also be favourable to them.

When the farmer rears his own stock, the value of the animals may be greatly increased by rearing from such breeds as are disposed to fatten freely, and milk well. The form, activity, and strength of his oxen, may also be greatly improved. The trouble and loss arising from mischievous bulls, when suffered to run at

* Animals, while young, delight in rapid exercise, and a continuation of it, which seems to be opposed to fattening.

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large in pastures, may be likewise avoided, by fencing the yard so that it cannot be broken by them. This animal, however, is generally quiet among his own cows in the yard: but if strange cows be brought to him, he will break the fence to pieces when they are taken away, unless it be very strong. The same will happen if the yard be so situated that he can readily see the strange cows, which commonly frequent the open grounds without the farm.

Some gentlemen tell us, that cattle fatten better in stables and yards than they do in fields. This may, and, I believe, will happen, if they have been reared in stables or yards; if, however, they have been accustomed to run at large, it will be found, (unless others are more fortunate than I have generally been,) that some of them are so much opposed to the best grass, when cut and given to them in the yard, that they will not fatten at all.

The cause of this seems to be evident. The previous habit of the animal is entirely opposed to this sudden change, from being accustomed to run at large, and gather such plants, or such parts of them, as are most agreeable to its taste. Experience, also, teaches us, that men, as well as the inferior animals, when deprived of that portion of liberty to which they have been accustomed, repine, and in some instances, actually die, from this cause alone. We likewise see, that the poor man's calf thrives, grows, and finally gives an abundance of milk, when it is principally fed with the scraps and slops originating in, and carefully saved by, his family, if they be industrious and economical. On the contrary, the fine, stately cow, reared in the luxuriant pastures of the wealthy grazier, commonly rejects this kind of provision, and is, in some instances, so much opposed to it, that actual starvation will scarcely induce her to eat this nutritive, but, at the same time, very cheap food. It frequently costs but little more than the trivial attention necessary to saving it, and the comfort and happiness of a poor man's family, in the country, depends so much on this single branch of economy, that they seldom prosper unless due attention be given to it.

Cattle are disgusted with grass which has been lying too long before them, in the savers, or cribs; neither do they like it if it has been cut and left in the field until it be withered, or heated, which speedily takes place. If the number of cattle be considerable, the whole of the grass necessary for the day cannot be cut, and brought to them in time, in the morning. It is, therefore, best to cut late in the evening, a small quantity, to last them until the food for the day can be cut and brought in. This small quantity will not heat through the night if it lies in swath, and should be given to the cattle so soon after daylight as it can be done. After which, the remainder of the food for the day should be cut and brought in with despatch. In the evening a sufficiency of fresh cut grass should be given to last them through the night.* Previously to feeding in the

* I believe, however, that the fattening of the cattle in yards, or stalls, would be greatly expedited if the grasses were cut fresh frequently through the day,

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morning and evening, all the old grass should be removed from the savers, and made into hay; for none need be lost: still, it is best not to have much of this remaining. Experience, however, will soon teach the provident farmer the necessary quantity so well, that but little will be left to be removed. But as some gentlemen of talents have urged the waste of grass, when cattle are fed in the yard, the reputation of the system requires that this complaint should be silenced, by convincing them that a handful need not be lost. The grass which the cattle reject, in consequence of having breathed too long over it, will make as good hay as any other of equal quality, if proper attention be given to the curing of it.

In the year 1810, beside soiling forty head of cattle and seven horses, the following products were obtained from eighty-five acres of land, to wit:

1730 bushels of potatoes,
817 do. Indian corn,
222½ do. barley,
69 tons of hay,
1391 loads of manure, of 32 cubic feet each.

The manure, however, was the product of winter as well as of summer feeding. The above produce, without enumerating the value of the dung, was estimated at 2,799 dollars.

One acre of rich ground, well set with grass, will fatten an ox of considerable size when pastured. I, however, doubt much whether the whole eighty-five acres would have been found sufficient to pasture the stock that was soiled, unless the season had greatly favoured the growth of the grasses.

So far as my judgment extended, it would have required at least, on an average, two acres of soil no richer than mine was, to have fattened each one of them. If this opinion be correct, and I fully believe it is, the produce stated above was clearly gained by soiling, except the hay, which, if the grounds had been found sufficient to fatten the cattle, might, in consequence of an early sale of that part of them which were the most thrifty, have been mowed after them.

One man, and a boy thirteen or fourteen years old, with a horse and an Irish car, (a low wheeled cart is better,) were found fully sufficient to soil the above mentioned horses and cattle. If the grasses had generally stood thick on the ground, they could have readily provided for many more. The boy harnessed and drove out the horse, while the man was mowing: also, assisted him in raking up the grass, loading, and feeding the cattle. Both the man and boy should be furnished with loose over coats, well calculated to

and given to them in small quantities, and that this might go far towards inducing even those who seem most opposed to this mode of feeding, to eat and fatten more freely. But of this I can say nothing certain, as my cattle were never fed in that way. The difference, however, would be little; provided enough of cattle were kept to employ the constant attention of one man and a boy.

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turn off rain. Neither of them ought to dread wet weather. It will, however, not be necessary to expose them to stormy and very heavy rains, as, when those occur the cattle may be fed with well cured first crop hay.

It might be useful to give them, frequently, a little well cured straw, with brine sprinkled over it in sufficient quantity to induce them to eat freely of it. This would correct too loose a habit of body, which often seems to procrastinate fattening when cattle are grazing, or fed in the yard on grass. I believe, however, that the older grasses fed to them, in the yard, purge them less than the young and tender shoots which they prefer when grazing in the field.

Salt appears to be actually necessary to domestic animals, if their stomachs have been long habituated to it, much like whiskey or brandy is to us, or opium to a Turk: therefore, it seems best for the farmer to give it to them; especially if he is fattening them.

When hay has been badly cured, or when it is rough, spongy and light, or when cattle, horses, or sheep are kept on any ordinary food, which nothing but necessity can justify giving to them, salting such food induces them to eat more freely of it: consequently, in cases of this kind, salt is both useful and economical. It is also useful when cattle reject good food because they have not been accustomed to it. This has several times occurred in the course of my practice. They have also rejected with me food that they had formerly been accustomed to, but had not eaten for some time previously to its being refused by them. Last fall when I commenced feeding with dried fodder, the corn tops and husks were rejected by a pair of oxen until it appeared that they would prefer starving to eating them.

I do not allow salt to be given to any of my live stock except those which have been long used to it, or as medicine, or to promote an appetite on particular occasions. As soon as some brine, made for the purpose, was sprinkled over the fodder, the oxen ate freely of it, and became so well reconciled to it, that notwithstanding the sprinkling of the brine was omitted in the course of three or four days, they have continued to feed as freely on the tops and husks through the winter as they do on good hay; which is never given to them except when they happen to be working at a distance from the farm.

It is urged that cattle, &c. are so fond of salt that they will encounter great risk to obtain it: therefore, it must be useful to them. It should, however, be recollected, that an Indian (and too many white men also) will do the same to obtain whiskey, although it does them more harm than good. No question but whiskey, when used on particular and proper occasions, is a very valuable article, and the same may be said of giving salt to cattle: but to render either practice extensively useful, the edge of the salutary effects produced by these stimulants should not be blunted by the habitual use of them.

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If I am correctly informed, British farmers have not been long in the practice of salting cattle or sheep. Yet that country has been a great while celebrated for rearing fine cattle and sheep. It is urged in opposition to this, that Britain is an island, surrounded by the sea, therefore salt is not necessary there. The interior parts, however, of that country cannot derive so much advantage from this circumstance as situations much nearer to our sea coast, where salt is considered equally as necessary for cattle as it is in the interior of this country, unless rivers or creeks impregnated with more or less salt happen to run so near to the farms that the cattle may have ready access to them.

Farmers will, of course, do what they may consider best. I would, however, advise them not to use salt for their cattle, &c. except in cases where it is evidently useful. The contrary practice clearly makes against its salutary effects when occasions happen which would render the use of it highly beneficial. The free use of salt is sometimes a serious expense: especially when land carriage greatly enhances the price of it, and the cultivator is poor. The profit arising from agriculture greatly depends on a judicious economy extended to all its expenditures: therefore, the establishment of any useless sinking fund, should not be sanctioned.

Small as the item of salt for cattle, &c. may at first sight appear, especially when it happens to be cheap, if it were possible to sum up the amount of money annually expended in this country for that purpose, it would be found astonishingly great.

As we, however, levy this useless tax on ourselves, we do not complain, unless we happen to believe that any act of our government has caused an increase in the price of the article.

If the farmer will omit salting a part of his younger live stock, and salt the remainder, as usual, he may readily determine how he ought to act. As this experiment will cost him neither labour nor money, he cannot err widely by giving it a fair and impartial trial.

Some gentlemen have recommended straw to be cut up with the grasses used for soiling. This will be found an expensive business. No advantage that can be derived from it will pay the expense.

When, however, horses or oxen are kept so closely at labour that they have little or no time to eat hay or grass through the day, and are fed with rich food, such as chopped rye, maize, &c. it seems best to mix straw finely cut with it, as the woody fibre introduced in this way prevents injury from the rich food. But when cattle are fattening on grain the woody fibre introduced by eating hay or grass given to them in the yard or stall answers the same purpose.

Many Pennsylvania farmers cut much straw to be mixed with the grain or chopstuff given to their cattle, &c. They consider the practice very economical, as it saves a good deal of hay. They would, however, soon find, if they paid for cutting the straw as fine and well as they generally cut it, that if a proper valuation be placed on it for litter, the hay costs them by far the least money. No

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question but they will agree with me that their own labour is quite as valuable as any other person's who does no more work. Also, that hay is vastly more nutritive than straw, and far better calculated to keep the bowels of the animals fed on it cool and open; the straw, in consequence of the little nutritive matters contained in it, being very binding.

The mistaken system of farming in England, induces many of the cultivators there to feed much straw to cattle. They are, however, compelled to make up the deficiency of nutriment in the straw, by feeding turnips with it: therefore, their practice should not influence us. The value of the straw for litter, added to cultivation, and extra dung necessary for the turnip crop, make that mode of feeding vastly more expensive than hay.

Too many farmers in this country, feed their cattle principally on straw, through the winter. They ought, however, to have known, that it contains but little nutriment. It is an obvious fact, that cattle which are kept in this way, are generally but little better in the spring, than skeletons covered with hide. Were it not for the little hay and corn fodder given to them, it is probable that the hide would be the principal profitable remainder of the farmer's stock, if nature had not wisely ordered that some few animals should possess sufficient hardihood to encounter hardships and privations, which the generality of the class to which they belong, cannot endure. These degenerate into a small but very hardy race, capable of living where larger cattle would perish with hunger, or by the diseases originating in poverty. Bad provision, ill usage and neglect, seem to be the principal causes of most of the diseases to which domesticated animals are subject.

Notwithstanding the great advantages that may be derived from soiling, it would seem that it cannot be generally practised even in the populous parts of this country. The quantity of cleared ground is more than double as much as the population is capable of cultivating properly, without introducing the additional labour which would be required if soiling were generally practised.

The farm yard manure acquired by soiling, and that introduced by the roots of the grasses, create, in the course of a single round of crops, such an immense improvement in the soil, that after the hay harvest commences, (which is great in consequence of the grass saved by this practice,) an almost perpetual harvest ensues until the corn is cribbed.

Each crop is heavy in proportion to the ground occupied by it. The labour greatly exceeds what would be readily imagined by those who have not observed the practice: still it may or ought to be partially introduced; especially by wealthy farmers, who have many workers in their own families. Also by those who have but little land in proportion to the labour they can readily obtain from their children, &c.

It should, however, be well remembered, that success is not to be expected, unless a full supply of green grasses, proper for this pur-

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pose, have been provided. The reader will find, that in my description of the grasses, care has been taken to point out such as appeared in the course of my practice, best calculated to promote the interest of soiling: also, the very great trouble and perplexity occasioned by red clover, in consequence of the cattle and horses being salivated by the second and third crops of this grass.

Every farmer certainly should soil his working cattle and horses, whether he may or may not enter into the general practice of soiling. A very small extent of ground will be sufficient for this purpose. This may lie so near to his barn, that the trouble will be little more, if as much, as going to the pastures after them. The grass and rich dung, saved by this practice, will be very valuable to him.

The size of the yard should be in proportion to the number of cattle, or the manure will be scattered too wide. A small portion of his cattle yard may be fenced off for this purpose. A division should be made between the horses and cattle, unless the farmer is well assured they will not quarrel.

An open shed will defend them and their feed from the sun and rain. I would advise the farmer to add to those horses and working cattle, one cow, to determine the difference between the quantity of milk obtained from soiling, and that from the pasture grounds: also an ox, to compare the progress of fattening in the yard with that in the field: but such animals as do not appear opposed to the practice of soiling, should be selected. I would also advise him to add a couple of calves, and the same number of pigs. This would show the advantage to be obtained from rearing such animals in the yard as were designed to be fattened in it; provided they are not suffered from first to last, to obtain any part of the food by grazing. A few sheep might also be introduced in the same way.

I have soiled hogs, but the experiment was badly conducted: therefore cannot determine any thing certainly respecting them; yet believe, from my general observation of the habits of that animal, that they may be profitably reared on grass, given to them in yards or pens.

Some of the hogs soiled by me had been accustomed to live through the summer on red clover, gathered by them in the fields: still, they did not appear to eat freely of it in the yard. Whether this proceeded from mismanagement or change of habit cannot be determined by me.

It is, however, very obvious, that pigs reared in pens will eat freely of almost any weed or grass gathered from gardens and fed to them in pens. It would therefore seem that they might be early taught to eat freely of almost any kind of good grass given to them in yards or pens. The second and third crops of clover may have been injurious to them in my practice, which continued only part of one summer and fall.

A few sheep were soiled one summer on my farm; but they appeared to claim so little attention that they were too often ne-

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glected by those who brought them in the grass. I did not, however, observe that they were opposed to the practice, and believe they might be profitably fed in this way.

A yard may be readily so constructed as to defend them from dogs, which seem to be more destructive to them in the older settlements than wolves are in the back-woods. The wolf does not often venture in the day near enough to the farmer's house to kill his sheep, and they are housed at night.

I have heard of no sheep being killed here by any other dogs but those belonging to the town. The cause of this seems evident: the farmer in the back-woods is compelled to keep a few sheep, as he cannot readily clothe his family unless this be done.

The dog, while young, is very fond of worrying the sheep, as he meets with no opposition but from the ram, and seldom from him. The farmer being well aware of the consequence unless this habit of the pup be broken, he is severely chastised as often as he is caught running after them. At length he becomes so fearful of committing this transgression that it would be found difficult to entice him to seize a sheep.

From this, and various other circumstances, it would appear, that if our legislators would lay a very heavy tax on every dog belonging to those who do not keep sheep on the premises where the dog resided, also on every dog more than one kept even there, we should seldom hear complaints of sheep being killed by dogs: provided the amount of the tax be sufficiently great, and annually doubled on those who prefer paying it to parting with their dogs.

As dogs can be of but little use except to farmers or butchers, there could be no reasonable complaint against this tax.

The fox hound seems to be the most voracious, and the least useful. Every man that is seen riding through any other enclosed grounds than his own after a pack of hounds, should forfeit and pay a sufficient sum to induce him to abandon this destructive practice.*

I was brought up in a small country town, and well remember the havock the dogs made among the sheep. They will assemble in packs and kill a whole flock of sheep in one night.

The dog, however, is a very sagacious animal, and readily taught. Hence it is that a butcher's dog will lie all night in his master's slaughterhouse, and, instead of devouring the meat, he will courageously defend it, if he has been properly taught.

The helpless timidity of sheep makes it more desirable to feed them in the yard than any other animal. It also appears that their constitution is not opposed to this practice. The little care that was too generally taken of them on the eastern shore of Maryland while I resided there, caused many of the ewes to die soon after they had yeaned. In this case the lambs were commonly reared

* In this case, also, the fine should be doubled every time it is repeated.

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in the negro quarters, and, when well fed, they generally prospered better there than any where else.

From the daring intrepidity which the house lamb acquired by living among the negroes in the quarter, it appears, that, notwithstanding the usual mode of domesticating that animal causes it to become timid and helpless, a more intimate acquaintance with man gives him confidence in his strength and agility. They commonly become so wickedly mischievous, if fully and well fed, that it is often found necessary to kill them to prevent some of the family from being seriously maimed by them.

This, and other obvious reasons, induce me to believe that when this animal is wild, and his security depends on his own prowess and sagacity, instinct teaches him when it will be proper to fight, and also when, and to where, he ought to retreat; and that he escapes at least as readily as do those animals who are much more timid and helpless than he.

We see that notwithstanding a multitude of timid and apparently defenceless animals are continually pursued and destroyed by others, who prey on them, they still exist in sufficient numbers to furnish food for those who destroy them. In fact, if this were not the case, and the weaker links in the chain of animal creation could be readily annihilated by the stronger, the whole chain would soon be destroyed, as the stronger, very generally, depend on the weaker for their support.

It is true that when man, the lord of inferior animals, encroaches on nature's domains, many of the links of her chain, which binds the great whole together, are broken to pieces. No bad consequences, however, arise from this new state of things, if he supply the deficiency by introducing a sufficient number of domesticated animals, and the necessary quantity of proper vegetation, and carefully spread the manure obtained from these never failing resources over the soil. As the contrary, however, too generally happens, we have to lament that poverty of soil, and all the evils which naturally arise from it, too commonly mark the footsteps of civilized man.

It is in the forests, and other wilds unfrequented by man, except in his savage state, that we may best learn the rudiments of natural philosophy. If these were better known, many of the theoretical errors which are so very injurious to agriculture, would disappear. Art, as well as error, have so completely defaced nature, in old, populous settlements, that those who travel to obtain knowledge of her, should traverse the wilds of America, in place of seeking this knowledge where it is not to be found.

But to return. The ram, in the apparently very unequal contest with the bull, has often fairly beat him, and in some instances, actually killed him on the field of battle. There is now on my farm a merino ram, which has become daring in consequence of his intercourse with man. He frequently beats my oxen, although one of them is a great fighter. Lest he might eventually kill them, it has

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been considered best not to admit him into the yard where they are kept. He has, also, several times knocked down a large house dog, which stays on the place.

As the ram is often equal in combat with horned cattle, and we do not hear that the latter are killed by wolves, although no care is taken to prevent it, why should we suppose that a wild, active, enterprising flock of sheep, (in which there would be, of course, a considerable proportion of rams,) incapable of that defence, and secure mode of retreat, which nature has implanted by instinct in every animal.

Want of practice weakens instinct in domesticated animals, so much that they seem incapable of bringing it into full, active use, except on such occasions as habit has rendered familiar to them.

The supposed natural timidity and incapacity of sheep to defend themselves, when wild, have induced some gentlemen to trace their origin to much larger and more enterprising animals, whose form bears some resemblance to that of the sheep, although, on the whole, they differ very widely.

We might, however, as well suppose, that, as there is a greater affinity between the domesticated cat, wild cat, and panther, that the latter had degenerated into the wild cat; and that the wild cat, in consequence of being domesticated, and fully and regularly fed, had degenerated into our harmless and very useful rat catcher: notwithstanding the precarious and very scanty support which wild animals obtain by prowling through the forest, and other wilds, is exactly calculated to abridge the size of them, while the plentiful and regular supply provided for domesticated animals, is well calculated to increase their growth. Yet the origin of the sheep has been traced to the mouflon, or argila, although the weight of one of them has been estimated at between six and seven hundred pounds.

Nature sometimes sports, and if proper advantage be taken of this, the properties of animals may be much altered for the better. But this supposed alteration in the sheep could not be effected, as it amounts to an entire renovation, or a new creation; and is equally as contrary to nature as is the erroneous opinion that wheat changes, and becomes darnel, or cheat.

The horse, either from his being habituated to confinement, or from some other cause, appears to be much less incommoded than cattle, with the change introduced by soiling. He will eat tolerably freely, even of second crop clover, given to him in the yard. Still, the effect produced by second and third crop clover is much more evidently seen in horses than cattle. The water runs in streams from the mouth of the horse, while we seldom see more of the complaint in cattle, than that while they are chewing their cud, froth gathers round their mouths, and drops slowly from them.

I shall never forget the effect that second crop clover produces on the different constitutions of both horses and cattle. Some few of each will retain their flesh, while the greater number fall away greatly.

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Having purchased of a drover, from the back-woods, a well looking pair of young horses, both did well on red clover, given to them in the yard, until salivation commenced. After this, one of them seemed to hold his own, while the other fell away, greatly. Being determined, if it were possible, to habituate the sufferer to this kind of food, a few weeks reduced him so much that his life seemed to be in danger. It required some considerable time, feeding on grain and the speargrasses, to restore him to his original plight.

Perhaps the merit of convertible husbandry, united with soiling, may be better illustrated by a comparative statement of the crops grown in the year 1811, with those sold to me by Mr. Shriver, and grown by him the same year that he sold the premises to me. His crops were considered large, and great efforts had been made by him to make them so. Both his crops and mine are rated at the same average prices, in the next chapter.

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CHAPTER XXXII.

The merits of convertible husbandry, united with soiling, explained and illustrated by a comparative statement of crops. On winter fattening cattle. Reason assigned why any given space of grass grounds will furnish much more food for cattle when the grass is fed to them in the yard than if they were pastured on it. On the use of oxen in place of horses.

Statement of Mr. Shriver's crops.

64 acres,	242½ bushels of oats at 43 cents, - -	$104.27
	12½ do. of wheat, barley and oat tailings, mixed, sold for - - -	5.83
	197½ do. of potatoes at 50 cents, -	88.50
	36¾ do. of wheat at $1.75 - -	64.31
	5⅛ do. of buckwheat at 50 cents, -	2.75
	9 tons of hay at $17.50 - -	157.50
	5 do. of corn fodder at $8.00 -	40.00
	226½ bushels of rye at 80 cents, - -	181.20
	155 do. of barley at 90 cents, - -	139.50
	250 do. of Indian corn at 60 cents, -	150.00
	8 acres rented to a widow lady, with the old farm house, and an old barn principally used for pasturing one horse and three cows,	100.00
	2½ acres rented to a negro man, with a small house,	29.16
	31½ acres in pasture, woods, yards and roads. The negro had the garden, which is included in his 2½ acres.	
106 acres.		$1.063.02

Statement of my crops.

13½ acres,	277 bushels of wheat* at $1.75 - -	$484.75
	25 tons of superior stubble crop hay at $7.50	187.50
15 acres,	1086 bushels of Indian corn at 60 cents, -	651.60
	196 do. of barley at 90 cents, - -	176.40
	23 tons of corn fodder at $8.00 - -	184.00
¼ acre,	263 bushels of potatoes at 50 cents, -	131.50
56⅝ acres,	130 tons of hay at $17.50 - - -	2275.00
	Received for soiling horses, - - -	72.35
	Sundries sold at market, - - -	37.10
20 acres in roads, gardens, woods, &c.		
106 acres.		$4.200.20

* This crop promised to be very large, but was very greatly injured by mildew. It, however, was sold for the above sum, delivered at my barn.

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As cornstalks, straw, &c. are seldom estimated by the full bred farmer, in the valuable amount of his crops, unless he happen to live near a town, where the straw may be sold, I have omitted them in the foregoing statement of my crop, lest the perpetual plougher and cropper might believe I wished to swell the amount. This makes it proper to remark, that when regular farming accounts are kept, the manure account should be debited to the crops of small grain and corn, for the straw and stalks. The latter has been considered by too many, as an article which costs labour, either to burn them, or plough them up. When the grounds, however, are properly prepared for crops, they will be found by those who try the experiment, fully equal, if not more valuable, than straw, for littering the cattle yard.

It appears from the statement formed above, that nearly a four-fold improvement was accomplished on this farm in the course of five years, from the practice that had been pursued; though many very injurious errors occured in the course of that practice. These greatly retarded the improvement of the soil, and were equally injurious to the products of it; especially of my fallow crops.

Every farmer who is in the habit of estimating the expense of cultivation, and that of taking his crops to market, may form a tolerably correct opinion of the clear profit which might be obtained from the produce, if subjected to his management.

But unless he were acquainted with the soil, on which these crops were grown, and also with the system of improvement, he could not readily form an opinion of the probable future annual increase of crops arising from an increased fertility of the grounds, and no calculation of mine can determine this sufficiently correct to hazard an estimate. I am, however, very confident that the fertility of the soil would have been very much increased, if the same system of management had been pursued during another round of crops, which would have terminated in the course of five years.

It was very obvious that the grass grounds were generally very deficient in fertility. This was made the more manifest by comparing the vegetation generally, with such spots as had been accidentally more highly enriched, and also with a part of the ground which had not been long enough cleared from its wood to be so much reduced by ploughing and cropping, as the land which had been longer cultivated.

Soiling, united with convertible husbandry, may be practised with equal success by every farmer; provided his cultivation be limited to an extent of clear ground, which will be consistent with his certain resources to cultivate it properly; unless where a range outside of his cleared grounds, furnishes a sufficiency of pasture for his live stock.

If the cultivator be not in debt, and possess a pair of horses or a yoke of oxen, two milch cows, four young cattle from one to four years old, six sheep, and rear as many hogs, as are sufficient for the use of his family, he may, with this stock, safely encounter

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twenty acres of cleared ground, and practise soiling, united to convertible husbandry; provided, himself, with the aid of the workers in his family, or those he can readily hire, and has money to pay, are sufficient to cultivate that quantity of land properly: especially as his live stock will increase with the increased fertility of the soil, if he give proper attention to that interesting portion of his management.

If the rotation of crops commonly practised by me, be adopted, four acres will be annually in manured fallow crops, four in wheat and other small grain, and the remaining twelve in grass.

When the farmer's stock is kept in well constructed yards, profusely littered, the quantity of manure exceeds credibility. Although the greater part of that which is gathered through the winter, consists of vegetable substances, they are well saturated with the rich juices of the cattle yard, which are lost by the improvident farmer. This mass being ploughed under the soil previously to fermentation, but little can be lost, if the crops be properly cultivated; and the roots of the grasses ploughed under with it, add greatly to the amount. The second and third crops of the grasses, when soiling is practised, may be more profitably mowed and fed green, or in hay, to the live stock, than ploughed under for manure.

Twenty acres of ground will appear, to many American farmers, too little, even for those who actually do not possess the means to cultivate ten acres properly, if soiling be practised. If they, however, would attentively compare the foregoing statements, some of them may alter their opinions; beside other things, which should induce them to do this, they will find the amount of products from the fallow crops grown by me, on fifteen acres of ground only, exceeded in value, the whole produce grown by Mr. Shriver, seventy-eight dollars, which sum would, in most situations, pay the rent of fifteen acres of land. They will also see, by reverting to my description of the cultivation of these fallow crops, that the corn crop, was very injudiciously managed.

The quantity of straw, and corn stalks, furnished by the crops, enumerated in the foregoing statement, was estimated at fifty four and a half tons. These dried vegetable substances, together with the leaves raked from the woods, and other offal vegetable matters that may be gathered, will, when saturated well with the juices of the cattle yard, form a great weight, as well as bulk of manure. If we suppose the offal vegetable matter, gathered in 1811, sufficient, if the cattle, &c. were properly managed, to make fourteen loads of manure, of thirty-two cubic feet each, which were the general size of my loads, it would cost the farmer thirty cents per load in the yard, and seven and a half cents per load for hauling it out to the field, or five hundred and twenty-two dollars for the whole, rating the leaves at the cost of raking and hauling, and the straw and corn stalks at three dollars per ton: also, charging the manure account, with the wages and board of the man and boy, and the labour done by the horse, employed in bringing in the grass.

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Thus we see that manure is an expensive article, whether it be bought, or made on the farm.

Some writers on husbandry say, that the profit derived from the sale of the cattle, should pay for the manure. It would seem, however, that if the farmer gets paid for the hay consumed by them through the winter, and the grass eaten by them during summer, that where hay sells at a good price, he must be an excellent judge of the value of store cattle, and their disposition to fatten, and also meet with a favourable time for purchasing them.

But if only the interest on the value of the land, employed to furnish the hay and grass, together with the taxes, and other necessary expense, and the cost of cutting, making, and securing the hay be estimated, it will greatly alter the estimate formed on the value of that article where it sells high; for, if seasons, good and bad, for making hay, be averaged, it may be cut, cured, and secured for two dollars and fifty cents per ton, if the management be good; still, if the farmer's or grazier's calculations be formed on these favourable principles, the expense of an ox, of an averaged size, will be found considerable, where land sells high; besides his proportion of the charges, enumerated above, he is also chargeable with an interest on his first cost, and on the money expended on making the hay, &c. with a per centage for the risk of his life, together with some other expenses, which vary so much in different situations, that they cannot be readily enumerated.

It clearly appears, however, notwithstanding the expenditures and risk naturally attached to keeping an extensive stock of cattle, that those farmers who are in the habit of doing it, if their management be good, always prosper much better, than those who pursue a contrary practice. The cause of this is evident; though a loss may sometimes occur in the sale of them, the advantage derived from their manure, more than overbalances it.

It is more than probable, that winter fattening cattle in stalls, often terminates in loss: still, many of the most thrifty farmers in Pennsylvania practise it; the same is also done by some of the best farmers in England. A gentleman there, who was extensively engaged in that business, has published, that he sustained a considerable loss on the cattlefattened in this way; yet he considered the practice, on the whole, the most beneficial he could adopt; and statements formed from regular accounts, seemed to determine, that the profit and improvement of his farm was great.

If this gentleman, however, had practised soiling, united with convertible husbandry, which he, and every other farmer, possessing sufficient capital might do, where population will admit it to be done, he could have obtained manure enough, on far better terms.

In fact, it would appear, that any system of management, which insures a certain loss, should be either amended, or abandoned: especially, as a well directed convertible husbandry alone, will, if the management be good, furnish a sufficiency of manure, without a general loss.

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When thrifty cattle have been well fattened with grass, good hay, with but little grain, will gradually improve them through the winter, if the management be good. It is by no means improbable, that ways and means might be devised, by which stall feeding through the winter would be profitable. My experience, however, has been so limited in this practice, that I am not sufficiently acquainted with the subject to point them out.

It generally happens, that the litter is so much exhausted through the winter, that a deficiency of it, joined with the continued rains, which sometimes occur during summer, cause the yard to become very wet and miry. The cattle are greatly injured, unless dry places are prepared for them, to stand and lie down in; this accommodation, however, may be readily provided, by raising the front of the floors of the sheds about six inches above the level of the yard, sloping them gradually higher, to the back part of the shed, so that the urine, and water from driving rains and snow, may readily run off. A compact clay may be best for forming the floor of the sheds, but mine were made with common loose clay, taken from such heights in the cattle yard as ought to have been reduced; so soon as they were finished, and moderately rammed, a thick covering of litter was spread over them, and the cattle suffered to go immediately on them; this seemed to answer well, as the litter prevented any injury from their feet, which soon consolidated the clay so firmly, that the floors required no litter until feeding with dry fodder commenced in the fall; after this, injury from frost was prevented, by keeping them well covered with litter.

Here it may be proper to inform the farmer, that unless this, or some other provision be made, to keep the cattle dry, soiling will not succeed: also, that nothing short of his particular attention to every part of the business can insure success. There are but few, if any, labourers to be relied on: more especially, in a business which habit has not rendered familiar to them; particularly if it be so little understood that the bad consequences arising from their neglect may be readily transferred to a defect in the system of management.

If they be not carefully overlooked, that method which renders the labour least troublesome to them, will be pursued. As it is easier to procure grass with the scythe than to rake it up clean, much will be left on the field. If too great a quantity happen to be cut, it will be found more convenient to mix it with the fresh grass, or to let it lie and destroy the grasses under it, than to make it into hay. As it requires some labour to remove the old grass from the cribs, and make it into hay, fresh grasses will be put in upon it. This seldom fails to cause the whole to become disgusting to the cattle. It is soon discovered by the labourer, that, in consequence of this negligence, the cattle eat much less. This too often induces him to bring in large quantities, for the express purpose of stalling them, that he may have less to do. When, however, he finds that the cultivator is vigilant, and making the overplus into hay increases his

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labour, he will abandon this practice. If cattle be stalled by being overfed with grain, or roots, it is often difficult to get them to feed freely after this happens. The reverse of this occurs when they are soiled, for if the old grass be carefully removed, and fresh grasses given to them, they will eat as freely as if nothing offensive to them had happened.

Cattle, when running at large in the yard, do not generally get so dirty as when tied up in stalls. Still, they should be daily examined, and if any dirt appears, it should be scraped off. This is readily done by a piece of old scythe, with a wooden handle attached to it.

Clean and fresh water is an essential article. The watering troughs should be daily well washed with a broom, and the dirty water let out at the plug holes in the bottom of them.

There are several very evident reasons why any given space of grass grounds will soil a great many more cattle than can be grazed on it; perhaps, at *least* three times as many. Cattle loath the grasses defiled with their dung, and will not eat those that grow around it. They reject such grasses as have been trodden down by them. The wounds inflicted by the feet of the cattle on the grasses, greatly procrastinate the growth of them, as does also the cropping of those plants on which they feed. There are but few grasses which grow rapidly immediately after being mowed, although this operation, when properly performed, cuts them off smoothly near to the ground. Whereas the mouths of the cattle, if the pasture be good, leave more grass standing, and sadly mutilated, than is profitably consumed by them. The putrefaction that takes place in many of the wounds thus inflicted, renders the grasses obnoxious to the cattle, as well as greatly procrastinates the growth of them.

When the grasses are used for soiling, no injury is inflicted on them, until they are cut off by the scythe. As this does not commence before the plants attain a considerable size, and the cutting of them progresses gradually as they are wanted; this gives time for a considerable proportion of them to grow much larger than those which were first used, and also for many of them to attain their full size: therefore, as much produce is obtained by soiling as the grounds are capable of yielding, except the loss sustained by cutting a certain proportion of the plants before they have attained their full size, which cannot be avoided in any case, except that of cutting them full grown for hay.

It is believed that the grasses, when considerably advanced in size, acquire a much greater proportion of rich, nutritive matters than when they are young. Also, that if they be cut before these rich matters are sufficiently formed in the plants, or after they have been applied in perfecting the seed, the hay is nothing like so rich and good as it would be, if cut when these rich matters abound in the stems, leaves, and flowers of the plant.

As observation on the economy of plants in general seems to substantiate this opinion, cutting the grasses for soiling cattle after

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they have attained nearly and quite their full size, may be justly considered one of the principal causes which renders soiling so much more economical than grazing. It would also appear that from this cause alone we have every reason to expect that if cattle be early habituated to soiling, by being reared up in the yard, and never suffered to obtain any part of their food by grazing, that they would fatten much sooner, and grow much larger, than if suffered to run at large in pastures: also, that working cattle and horses fed in the yard, on the older, and, of consequence, much more nutritive grass, will require much less grain than those that are pastured. As it will require but little more time for them to eat a sufficiency of grass, in the yard, than is necessary for them to become cool enough to be safely fed with grain, very little, if any, of their labour, will be lost by this practice.

Oxen, when hauling, or doing any thing else that gives sufficient rest, during the time of putting in and taking out the loads, require no other food through the summer but proper grasses given to them in the yard: provided they have been well accustomed to being fed in this way.

If, however, they be hitched to the plough or harrow, or put to any kind of labour which demands continued motion, they require quite as much, or more grain, than horses, and, after they have eaten it, are not capable of performing any thing like as much work, if the weather be only tolerably warm. If it be very warm, no management, or feeding, will enable the ox to labour continually with tolerable advantage to the farmer.

Many gentlemen have laboured hard to prove the contrary. They might, however, have seen that nature had not formed the ox for long continued motion, even when the weather is only moderately warm, unless that motion be too slow to be profitable to the cultivator. In winter, or when the weather may happen to be cool, if he be well shod, and fully fed with grain, he may encounter long journies in a team with tolerable advantage to the owner.

As every farmer, who has a sufficiency of capital, should keep a full stock of cattle, he will find the ox more profitable than the horse; provided he rears in the yard, or purchases while very young,* a sufficient number of steers, and breaks them at three years old to the yoke, and works them moderately until they have attained their full size. At this age they will fatten more freely, and yield more tallow, than either before or after that time.

Steers are more readily broke at two years old, and if worked very moderately, and well fed, will, it is said, grow the better. It, however, at this age, requires so many of them to drag the plough, that driving would be found a troublesome and expensive piece of business.

* If I am not greatly mistaken, he will find the former practice much the best, as even an early habit is not readily subdued, especially if that habit be implanted by nature.

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Oxen should be taught to walk fast while working, but ought to be unhitched and turned into the yard to rest and eat so soon as they appear to be rather flagged, and their place supplied by others that had been resting and eating in the yard.

When oxen are managed in this way, the work may be nearly as quickly done by them, when kept on cut grass through the summer, and good first crop hay during winter, as by horses well fed with grain.

It will, however, require more than double the number of them, than it would of horses, to do the same work with equal despatch. Besides the necessary rest, those that are only three years old cannot endure labour so well as if they were more advanced in age, and had been longer accustomed to it.

However, as the farmer who is able to do it, ought to keep an extensive stock of cattle,* and as it is believed by many that the size of the ox is increased by moderate labour if he be well fed and treated, there seems to be no rational objection to the multiplied number of them.

Much has been written to convince us that it is most profitable to fatten and sell steers while they are quite young: still, there seems to be every reason to believe that the growth of the ox from three to six or seven years old, is at least quite as profitable to the farmer as his growth at, or any time previously, to his attaining three years of his age, more especially if his labour be estimated.

A certain loss arises on the horse, unless the cultivator commences jockey, and has sufficient skill to keep up a continued stock of young horses, with paying but little difference, in exchanging the older for younger ones. This is, however, a practice that cannot be justly recommended, as the loss eventually falls on those who have been overreached in this disgraceful traffick.

The harness for horses is very expensive, more especially if the oil, labour and mending necessary to keep them in repair be estimated. The same expensive harness has been recommended for the ox, and respect for Mr. Bordley's opinions induced me to give it a fair trial. The result clearly convinced me that the yoke and bows in common practice are far better: especially if a short forked chain (as it is called here) be extended from the tongue or chain, by which the cattle draw, to the yoke, and so fixed as is best calculated to prevent the oxen from taking an undue advantage of each other, and also to keep the yoke in the proper position on their necks. The whole of this costs but little, is readily put on and off, and requires but little time or money to keep it in proper plight.

* This opinion, however, should have scarcely so generally prevailed if the growth of the ox was considerably retarded by moderate work: the question, however, is a difficult one. Practice seems to have determined that the calf while young grows larger and fattens much more freely when confined than when suffered to run at large. The hog when closely penned up grows to a great size if he be fully fed.

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The necks of oxen are sometimes galled by the yoke, especially while they are young. If this happen, sheepskin closely covered with short wool should be immediately nailed on the yoke, with the woolly side out; and so placed as to keep the wood entirely from the neck of the animal; likewise, so that the sheepskin will not wrinkle. This has never failed, with me, to effect a cure of the galls, when observed before they became extensive.

Too many of the gentlemen who have endeavoured to bring the ox into more general use, have greatly injured the cause they intended to promote, by endeavouring to convince their readers that the ox is equal to the horse for agricultural purposes, provided he be properly formed and managed.* This has introduced the useless, expensive, and troublesome harness used for horses; and as one horse carts happened also to be fashionable, the ox, too, must be used in that way, although the usual and only rational plea of being placed near to the draught is not applicable to him, as two oxen may be more readily fixed in that way than one. It has, however, too often occurred, since the rage for gentleman farming commenced, that it matters not how erroneous the theory or practice may be, if it happen to be fashionable.

Overrating the properties of the ox so much, gives those who are opposed to him full opportunity to demonstrate that his advocates are egregiously mistaken in many things urged in favour of him. This, of consequence, more or less invalidates the whole that has been advanced by them.

The great feats which have been achieved at plough races, by oxen, pampered, exercised and kept like race horses, for this purpose, have also excited expectations from them, that can never be realized in practice.

When those who have been deceived by this inconsiderate piece of business, discover their error, they too frequently become prejudiced against this very useful animal, for no better reason, than that they expect more from him than he is capable of performing.

The desire to introduce the use of oxen in the place of horses, has been such, that even Mr. Bordley, who must have known the bad effects produced on the eastern shore of Maryland, by feeding too much straw to horned cattle, says in his book on Husbandry, "A horse costs as much as four and a half oxen, and the keep of the ox, in summer, is grass alone; in winter, straw: on which they may be worked moderately; if hard worked, they have hay."

An ox cannot work hard on hay, and so far from being able to

* If it could be admitted that some gentlemen by great attention to breeding have reared oxen which do as much work as is commonly done by what are called good plough horses, would not the same effort of art, if it had been also employed in improving the breed of plough horses, have kept up the same distance between the horse and ox that existed previously to any especial care being taken to improve the latter? It would seem that this cannot be doubted by those who have noticed the marked difference in horses, apparently of the same size, not only in quickness of motion and durability, but also in strength.

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work moderately on straw, he is reduced to a skeleton if kept on it without working, unless his constitution be peculiarly hardy.

It may be useful to observe that the ox, when worked on grass, is sometimes scoured severely, especially if the grass be young. So soon as this is seen, he should be kept from grass, and fed on hay and oats, until the complaint be removed. If it be suffered to run on him, he will fall away greatly, and become too weak to labour hard.

The same, also, sometimes happens when the ox is worked in winter, and fed either on turnips or potatoes with hay. The remedy is oats in place of these roots, until the disease be properly checked.

The ox is naturally sluggish. However, bad and lazy drivers, scanty or improper food, or longer continued exercise than the animal is capable of enduring, unless he be driven very slow, are the principal causes of his becoming so insufferably slow in his motion.

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CHAPTER XXXIII.

How the Pennsylvania back-woods farmer clears his grounds. On stripping off the leaves from the trees in the spring. On the inconsiderate waste of timber. On the system of cultivation pursued by the Pennsylvania back-woods farmer. How the Yankee back-woods farmer clears his grounds. On the destruction introduced by his mode of burning the soil. How this injury is best seen. On improving the poor places, which appear in grounds recently cleared; and how they originate.

When the Pennsylvania farmer enters the forest, he commences the clearing of his grounds, by girdling the timber. If time will admit, this is best done in August, the year preceding that in which he means to till the soil. The trees are more readily destroyed by girdling, or any other injury done to them, at that season of the year. This mode of management gives time for those that may happen to linger, to become entirely dead. Also for observing and girdling more effectually, such as would either survive or linger too long. After the trees are girdled, the fallen timber is logged off, or cut into proper lengths, and the grubs taken up by the roots. When this is done, the smaller trees are cut down and logged off. As the numerous and drooping limbs of the spruce, pine or hemlock, shade the crops too much, even after their foliage have been destroyed by girdling, they are also cut down, unless they are so large or so numerous that the farmer's force or capital cannot effect it. In the latter case, if he or his sons be active, the limbs are sometimes chopped off near to the trunk, by commencing at the top of the tree, and proceeding downward. As the limbs are small in proportion to the size of the tree, the task is not very laborious. They actually fall around the tree, and burn very freely. Therefore, girdling is in this case, omitted.

However, without the aid of girdling or the fire kindled in the brush, the tree would die, as it and the white pine appear to be incapable of surviving the destruction of their limbs and foliage. From which it seems reasonable to suppose that a very considerable proportion of their support is gathered from the atmosphere: especially as a much greater body of these kinds of timber exist where trees of this sort prevail, than we generally see on grounds of equal capacity, where trees of this description do not constitute the principal part of the timber. We also often see nearly as much heavy deciduous timber perfected on the soil, as it appears capable of supporting, together with a very large body of white or spruce pine, or both intermixed among it.

Here I beg leave to remark, that Sir H. Davy says, "if the leaves

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are stripped off from a tree *in the spring*, it *uniformly* dies."* Nothing can be more erroneous than this unqualified assertion; it proves, however, as does the general tenor of his book on Agricultural Chemistry, that gentlemen should not attempt to explain subjects with which they are not practically conversant. White and spruce pines seem to depend much on their foliage; there may be also other evergreens, and some deciduous trees, that do the same; it is, however, well known to every farmer in the back-woods, that trees generally are not so readily killed, as Sir Humphrey seems to imagine: especially *in the spring*, as at that season of the year, nature sooner repairs any damage that may happen to be done to them.

It has been before observed, that green poles formed into a fence, and the logs with which our cabins are built, sometimes vegetate, and produce branches and leaves, and that fence stakes, formed with green poles, often take root and grow.

It will be readily granted, that cutting down a tree deranges the economy of it, much more than stripping off its leaves; the stumps of some kinds of trees, which have been cut down in the spring, or at any other season of the year, vegetate from the sides, as well as the roots of them, so often, and profusely, that I have had to cut off a new growth of sprouts proceeding from them, every time the fallow crop, grown on the grounds where the stumps stood, were cultivated,† I have often seen, not only the leaves, but also the limbs removed, from deciduous trees, and a new set of thrifty branches and leaves formed: these branches commonly grow with great rapidity, in consequence of the great quantity of nutritious matter supplied by the extensive organ of nourishment connected with them.‡

But to return. The sugar tree, common maple, &c. are seldom effectually killed by girdling. If it be convenient, they ought to be cut down; when this cannot be done, the brush and underwood should be heaped around them, in sufficient quantities to burn off all the bark about three or four feet above the ground, and also to affect the interior parts of the tree by heat so much, that its vegetative powers will be destroyed.

The brush and grubs are commonly first heaped and burned to make room for rolling, heaping, and burning the logs; after this, the chips, with the small pieces of the brush, are raked, or gathered into heaps, and burned, together with the rotten trunks of trees, and

* See his Lec. on Agr. Chem. page 67.

† If these sprouts are suffered to grow, those nearest to the ground take root, and form perfect and thrifty trees.

‡ Here another fact is seen; while the powerful principles of life can freely act on the upper structure of the trees, but few, if any, branches ever appear on the body of it, which nature had trimmed by shade. When the tree, however, is cut down, she rouses into action, the sleeping buds in the stump, which had lain torpid for ages. How wonderfully minute then must be the organization of a tree, while the whole of it lies sleeping or torpid in the seed, especially, as some of the seeds which form the whole structure of the largest trees in our forests are very small.

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other combustible matters, that may be in the way of the plough, or, that had accumulated in sufficient quantities to injure vegetation.

Some Pennsylvania farmers, after they have made a sufficient clearing in this way to answer their immediate purposes, cut down all the timber in their future clearing, and would have greatly preferred this mode of management in the beginning, if they had considered it practicable to procure a sufficiency of soil in that way to support their families and cattle.

But either from a lack of that enterprise, which marks the Yankee farmer in this kind of business, or some other cause, the whole of the timber is seldom removed by the Pennsylvania cultivator. It would, however, seem, that practice not only reconciles the Yankee to the laborious task of removing all the timber, but also enables him to execute the work with much more skill and despatch than the Pennsylvania farmer.

Where there is a rational prospect of bringing the timber into profitable use, before that degree of decay takes place which causes it to fall on the crops, it should not be cut down. It would, however, be very difficult to convince the farmers in my neighbourhood, where the trees are larger, and thicker set together, than I have ever yet seen them grow, that it is possible a scarcity of timber could ever happen here; still, I do not question, if the settlement should from this time progress as rapidly as many others have done, that some of them may live to see the day, when their farms will not afford a sufficiency of it to fence their grounds, notwithstanding they possess the advantage of inexhaustible banks of stone coal for fuel.

Man is the most destructive animal in the universe, when he considers that his resources cannot fail. Reason furnishes him with many inventions, to overcome the obstacles to his favourite plans.

In new settlements, the timber is commonly the greatest obstacle to cultivation; this begets an emulation to destroy it; he is considered the best farmer, who clears the most land. This enterprise would be laudable to a certain extent; the habit, however, of considering the timber in the way, induces the farmer to wage a perpetual war against it, until his eyes are opened, by finding that he has neither fencing nor firewood left.

This mania is greatly increased from an opinion that his crops are multiplied in proportion to the extent of his cleared grounds. It is the too general practice with the Pennsylvania back-woods farmer, to continue ploughing, or rather scratching his grounds annually, until they are so much exhausted that cockle, cheat, and other weeds form by far the principal part of his crops. This compels him to give rest to the soil, until nature has spread a thin set covering of debilitated grasses and weeds over it. Necessity, therefore, urges him to clear more land. As this is also worn out by the same system of management, he presently finds, that products sufficient to answer his purposes cannot be obtained, unless an extensive clearing is made. This is a true picture of Pennsylvania back-woods farming as it is generally pursued.

There are, however, exceptions to this too general practice; for

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some back-woods farmers do give considerable attention to grass and manure; but they are few indeed, when compared with the number of perpetual ploughers and croppers. These last mentioned cultivators, commonly gather all the hay used by them, from a little patch of perpetual meadow ground. On this the farmer spreads the little manure made by his scanty stock, if his other engagements will admit it to be readily done. It would, however, appear that this little patch is too often neglected, as we frequently see the manure heaped about the doors of the stables so high, that it is difficult for his horses and cattle to get either in or out of them. Nay more, the entrance into the stable doors, is sometimes so confined by the dung heaped up around them, that even the farmer's sheep, which wolves compel him to secure at night, find it difficult to get in or out of them.

It is said, and I believe it, though I have not witnessed the fact, that the dung has accumulated round some barns in such great quantities, as to render access to them so difficult, that they have been burned and new ones built. As the farmer considered this more economical than encountering the labour of removing the manure. Now it is by no means wonderful that we should so often hear such cultivators complaining that their winter grain had been smothered by snow. For whether these crops are or are not sometimes injured by this cause, it is evident they cannot withstand the vicissitudes of inclement seasons, when the plants have been starved and debilitated by lack of nutriment.

But to return. The Pennsylvania back-woods farmer commonly depends on the hay procured from his little patch of perpetual meadow ground, together with the straw grown on his impoverished fields, to keep his cattle from perishing through the winter. If the winter, however, happens to be severe and protracted, many cattle are lost from lack of nutriment alone, or the diseases introduced by starvation.

If such a farmer as this commence with one hundred acres of land, by the time he becomes advanced in years, and his debility greatly increased by the excessive labour encountered in clearing his grounds, he has to lament over the barren waste which his folly has created, and which he has not funds to repair. His sorrow will be greatly aggravated by observing that timber has been so scarce and valuable that one acre of tolerably well set woodland will sell for more money than five acres of his impoverished soil. His vexations will be still more increased, if he be eventually convinced that he might have lived much better, and with infinitely less labour, on thirty acres of cleared grounds, properly managed, and maintained or increased the original fertility of it: also preserved seventy acres of his woodlands. There can be no doubt, but the dead and fallen timber would have supplied all his wants, and furnished a considerable overplus, which might have been advantageously sold to his less provident neighbours, and that the growth of the young timber would fully supply the deficiency arising from the fall and decay of the older trees.

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If one half or even more of all the grounds now cleared from their wood in our older settlements, had been suffered to remain covered with timber, the remaining half, or even less, would have produced much more than the whole now does, provided its original fertility had been preserved, and only a tolerable good system of management pursued. More lumber, tar, pitch, turpentine and potash might also have been exported. The farmer would have had time to economize and judiciously employ the substances from which those articles are formed. If this had been done, it would have given foreign nations as high an opinion of American prudence, as recent events have given them of the hardihood, activity, talents and enterprise of our citizens.

The Yankee farmer first chops the fallen timber, then scalps off the grubs level with the ground. After this, he cuts down all the trees, taking care that they fall regularly, side by side. The branches are then chopped fine enough to lie sufficiently compact to favour the burning. Some log off the timber before, and others after the fire takes place. In either case, the whole is suffered to lie until the wood is sufficiently seasoned, and a dry time is chosen to set fire to the mass. After this, the logs are heaped and burned with any remaining chips, or bits of brush, found on the ground.

The grounds are not ploughed, but well harrowed, by a very heavy harrow, with strong and heavy tines, formed for the purpose. Wheat is commonly the first crop.* This is generally followed by rye sown on the wheat stubble, without ploughing for it. The grounds are, however, well harrowed by the same heavy harrow, previously to sowing the rye, and grass seeds are sown on it. Some Yankee farmers take but one crop of small grain, and sow grass seeds on it. In either case, if the cultivator be a good one, the grounds remain in grass until the roots of the trees have sufficiently decayed to admit the plough to pass through the soil, with much less labour and inconvenience than it would do when they are sound. If the roots happen to be of those kinds which sink soonest into decay, they are commonly so rotten before the grass grounds are cultivated, that they present no very serious obstacles to the plough.

If the soil be a good one, the wheat crop following the burning is luxuriant. The rye is also respectable, and so are the grasses following it. These are all obtained without the expense of grubbing or ploughing. The texture of the new grounds favours the processes of vegetation, for they had been kept open and mellow by the covering which nature had wisely provided for them. This, with the stimulus of the salts contained in the ashes, together with the animal and vegetable matters which escape the burning, are capable of producing very large crops. Perhaps a better method could not be devised for clearing woodlands, or a more profitable first

* Indian corn, and also potatoes, are frequently a first crop on a part of the Yankee farmer's grounds. Both those crops commonly prosper well. Wheat, or any other small grain, except oats, however, seldom prospers after corn or potatoes, when the grounds have been cleared by burning in the Yankee way.

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course of crops be introduced, if it were not that by far the greater part of the animal and vegetable matter which nature had been accumulating for a great length of time, is destroyed in a day or two, by the destructive and truly inconsiderate and savage practice of burning.

The destruction introduced by the burning is best seen when the Yankee method of clearing, and the Pennsylvania practice of ploughing and cropping, are united. I know a farmer who removed to the back-woods, purchased five thousand acres of land, built a sawmill, and did many other things, which cost him much labour and money. He, however, abandoned the whole, and assured me he could get no person to live on the premises rent free when he left it.

Now, if this gentleman had followed either the Yankee or Pennsylvania practice, separately and judiciously, he would have succeeded, and the increased value of the land would have made him eventually wealthy. By mixing both modes of management, he was ruined, as is many a farmer, by moving into the back-woods without being acquainted with the business he has to encounter.

He was an Englishman, and considered in this country a good farmer, both before and after he lived in the back-woods. Among other things, he informed me, that he had cleared ten acres of ground by burning in the Yankee way. From this he obtained a luxuriant crop of corn, with no other labour than that of planting it, and cutting off by the ground, with the hoe, a few scattering weeds, which grew up, here and there, among the plants. Finding, however, that after this the grounds grew no profitable crop, but oats, and that all the land he had cleared and cultivated was generally reduced to the same state, he removed from the back-woods. After his return, I asked him if he had ever tried sowing grass seed, at an early date, and suffering the grounds to lie some considerable time in grass, before they were ploughed for cultivated crops. He told me he had not; and indeed, as I believed from his conversation, had not even thought of renewing them in this way, or supposed that they had been injured by the burning. After some little conversation, however, he seemed to think that the practice might have succeeded. I urged him to return and make the trial, and am now far better convinced than I was nearly six years ago, when this advice was given, that he would have succeeded. He had, however, suffered greatly, and his funds seemed to be too much reduced to renew the struggle, with any very confident hope of success.

Grass is nature's infallible restorative; and while the stimulus of the salts contained in the ashes continues to act, it will greatly increase the number and size of the roots and tops of the grasses. These will, therefore, most assuredly return to the land a considerable portion of what it had lost by the burning; especially if the tops of grasses be turned under the soil, when the lay is broken up for cultivated crops.

But why should this inconsiderate waste of animal and vegetable

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matters take place? It is readily granted that the labour is less: also, that if the soil be deep and rich, much of these matters will escape the burning, and that the first round of crops will be good. Still, reason and observation clearly determine that the texture of the soil immediately after it is cleared from its wood, is exactly calculated to suffer immensely from fire, in dry times. It is formed of vegetation, which is only partly decayed. This, when dry, will burn like tinder, until the firmer earthy soil underneath puts a stop to the progress of the destructive element. When those partly decayed and open spongy substances are intimately blended by the plough and harrow with the firmer earthy soil underneath them, the crops are excellent, and the soil is no further exhausted than is actually necessary for the support of the plants grown on it: consequently, it will be found vastly richer than it could possibly be after the destructive practice of burning. This fact is so very obvious to common sense, as well as practical observation, that it cannot be rationally controverted. Yet paring and burning the soil has been in very common practice in England, and is now advocated there by gentlemen of celebrated talents. As many of our agricultural errors, as well as improvements, have been copied from the practice of that country, this may be the reason why the Yankee farmer does not seem to suspect that burning injures the soil. He appears to sow grass seeds merely to get rid of the trouble of ploughing among roots and scalped grubs, until time has rendered this operation less difficult; and to introduce the practice of grazing which he has been early taught to respect.

It is evident, however, that the judicious parer and burner of the soil, in England, is governed in his practice of laying down his grounds in grass, from observing when this has not been done in time, that the soil is ruined; as in the defence of his erroneous system, he says, no injury arises from the burning, if the grounds be properly manured, or returned in due time to grass. He, however, at the same time affirms, that if grass seeds be sown in time the improvement is great. This may be very true if plenty of enriching manure be applied, as is generally done when good farmers cultivate the soil by paring and burning. The application of this is not necessary for the first crops. It is, however, commonly used previously to laying down the lands in grass, unless they happen to be old and rich grass grounds. In that case the burning opens the texture of them, by reducing the consolidated and matted sod. The young and vigorous grasses produce good crops, and the soil being at the same time filled with their roots, an improvement seems to be made without manure. But if the paring and burning were soon repeated, it would be quickly seen that the grounds were far less capable of withstanding the loss of the animal and vegetable matter destroyed by the second ordeal; and that a regular continuation of this savage practice, without the use of much enriching manure, would sooner and more effectually ruin the richest and best of soils than any other mode of management that has been yet proposed.

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In the clearing of our woodlands the brush and log heaps are burned at random. This is a bad practice. They ought to be burned on the richer ground near to the poorest spots in the clearing. In this case as much of the ashes as is necessary to excite the growth of the cultivated crops and grasses following them may be readily spread over these poor places. This will not only greatly increase the cultivated crops and grasses on those thin or poor crops, but also enrich them for the growth of future crops by filling them with the roots of the grasses. If the heaps be burned on the poor places, the burning leaves too little animal and vegetable matters for the salts in the ashes to act upon.

Many poor places are formed by the trees being blown up by the roots. These are generally very numerous where the timber is large and its roots superficial. The winds act much more powerfully on very tall trees. Their superficial roots appear to be less capable of holding them in the ground than roots which grow deeper into it. It also seems that those wide spreading roots which run near the surface of the soil bring up a much wider extent of ground with them when the tree is blown down. The large hole made by the blowing down of the tree lies immediately behind the roots of it. The bottom of the hole is composed of poor, inert earth, incapable of supporting vegetation, unless the soil is very deep. This seldom happens except in rich bottoms formed by the deposition of ages. As the bottom of the holes lies considerably deeper than the surface of the adjoining soil, the winds, together with washing rains and melting snows, lodge much animal and vegetable matters in them. This, during a long lapse of time, gradually fills them sufficiently, by the decay of these substances, to make them much richer than the soil around them. The earth removed by the roots of the tree is confined by them until the frost and rains gradually remove it. The richest, and of consequence the lightest part of the soil, falls off from the front of the root first. As the texture of this is open and light, a considerable proportion of it is washed away by the rain and melting snows. After this, the poor, heavy, compact earth which had been more closely confined by the roots of the tree gradually falls off and forms a poor hillock. From this the principal part of the leaves and other vegetation falling on it is naturally washed or blown off. Nothing can well exceed the poverty of the hillock formed in this way, even after no vestige of the fallen tree which formed it remains, and very frequently after a tree equally as large as any within sight of the place is seen growing on the top of this poor mount. It would seem that the tree standing on it must have grown very slowly, until its roots had pierced through the poor ground and become established in the richer soil underneath and round about the mount. Be this, however, as it may, these hillocks are very often thickly dispersed in every direction through forests which consist principally of timber that forms wide spreading superficial roots, or where this kind of timber had formerly prevailed. After the

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grounds have been brought into cultivation, scarcely any thing worth gathering is found to grow on them, until by long continued cultivation they have been leveled down to the better soil, which had been for ages buried underneath them.

The causes of the formation of this hillock is readily seen, by observing what has happened where trees have been recently blown down, also where they have sunk, less or more, into decay, until no vestige of them remains.

I have been the more particular to describe these hillocks and the causes which form them, because they often greatly injure a considerable proportion of the soil where large timber with superficial roots had prevailed, and farmers take no measures to render them fertile; although they both see, and extensively feel, in the product of their crops, the evil introduced by them, and actually possess the means of improving them readily in the way that has been in part pointed out. To complete the improvement, the roots which will be removed from the stumps in the different cultivations of the ground should be regularly burned on the richer grounds near to the hillocks, and the ashes spread on the latter. If this practice be regularly pursued, these poor places will be fertile until they are leveled down by cultivation to the richer soil underneath them.

There are other causes which make a great difference in adjoining soils, that have remained for ages under nature's control. The animal and vegetable substances are swept away by torrents of water, and high winds, in large quantities from hill sides; more particularly in northerly exposures. We also see, even in the lower grounds, that torrents of water or some other cause have formed wide and deep hollows. That notwithstanding time has covered the sides and bottoms of them with soil and timber, the soil on the sides of the declivities, is often much poorer than that on the adjoining grounds above them, as animal and vegetable matter gathers on places from which much of it is washed or blown off.

The hill sides and declivities ought to be managed in the same way as has been recommended for the hillocks. Great care should be taken, when the grounds are cultitated, to form the water furrows in that way which will be best calculated to prevent the soil on the hill sides and declivities from being washed away. If either or even a small part of them, are too steep to be profitably continued in cultivation, grass seed sought to be sown on those spots with the first cultivated crop, and the grounds continued in grass. In this way they may be always rendered more or less profitable; but it is useless and very injurious to cultivate grounds, from which the soil must be soon washed away. If they be laid down in grass before they are exhausted, their fertility may be continually preserved by letting a full crop of grass decay on them as often as this may be found necessary. It is best to manure grounds of this description, by letting the grasses rot on them, as enriching manures spread over them are more subject to be washed away.

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CHAPTER XXXIV.

The cultivation pursued by the Pennsylvania back-woods farmer, contrasted with that practised by the Yankee. The Yankee mode of clearing new grounds, may be readily altered, so as to be by far the best practice that has yet been pursued; and how this may be done. On the best method to be pursued in the cultivation of the different kinds of new soil.

It very clearly appears that notwithstanding the Pennsylvania back-woods farmer's system of clearing woodlands, is not calculated to injure the soil, his perpetual ploughing and cropping with but little attention to grass or farm yard manure, renders his mode of management vastly inferior to that of the Yankee.

Except the destruction introduced by the latter, in clearing the land, his system of management, if he be a full bred, well informed Yankee farmer, is ameliorating. Every means in his power is taken to increase his live stock. He depends principally upon them for the provision and clothing used by his family, and on the sale of them to purchase such necessaries as he cannot obtain from his grounds; also to pay for his land. This he generally purchases on a long credit, dividing the amount into easy periodical payments.

The Yankee method of clearing woodlands would be excellent, if in place of waiting until the wood became dry, and selecting a dry time for burning, he would run the fire through the clearing when the leaves, smaller parts of the brush, chips, and other light vegetation are sufficiently dry to be burned without injuring the soil, by burning those vegetable substances underneath them, which have in part sunk into decay, and which, though very inflammable when they are well dried, and powerfully excited by a considerable fire in wood above them, will remain uninjured by the burning only of the leaves, smaller parts of the brush, chips and other light vegetable matters lying above them, if this be done when long continued dry weather has not exhaled the moisture in the soil. As while a sufficiency of moisture remains to keep the fire from running deep into it, no injury will be done, except where the log and brush heaps are burned. In those spots, especially where the log heaps are burned, the heat will be so intense that the little soil covered by them will be greatly injured by the destruction of the animal and vegetable matter contained in it. As this, however, is an evil that cannot be avoided, it should be patiently borne.

The ashes introduced by the lenient system of management recommended above, together with those spread from where the log and brush heaps are burned, will afford a sufficient dressing to excite the new soil to an immediate fertility, at least equal to that ob-

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tained by the Yankee method of burning. If potash be desirable, it may be made before the ashes are spread.

If this mode of clearing be pursued, the grubs should be removed. Of this, however, the farmer should not complain, for although many of them are killed by the Yankee practice of burning, a sufficient number survive this truly savage ordeal, to give the cultivator considerable trouble, and also to injure his crops.

The grounds cleared in the way which has been proposed, ought to be ploughed and harrowed sufficiently, to blend the partly decayed vegetable matters, intimately with the earthy and more solid soil, lying underneath them. For notwithstanding, a sufficiency of animal and vegetable matters, are necessary to a luxuriant growth of plants, too great a body of these substances, especially when they have sunk into but a very partial decay, and are not mixed with a sufficiency of earthy matters, are very injurious to it, and may be so superabundant as to destroy it.

The reason why new grounds, which have not been burned in the Yankee way, are considered too wild for some crops, but most especially for the growth of maize, is as obvious as almost any other thing. The roots of the plants cannot prosper in the open, and but too often dry, and inert texture of such soils. Earth is quite as necessary to an efficient vegetation, as the other ingredients, which are commonly mingled together with it; it is the happy mixture of the whole of them combined, that constitutes the rich and fertile soil. Therefore, when the Pennsylvania farmer pursues his method of clearing woodlands, all the leaves, and light dry vegetable matters, found on the surface of the soil, together with the partly decayed vegetable matters proceeding from the decay of the trunks and larger limbs of the fallen timber, should be gathered, or raked up into heaps, and burned; even the decayed, powdery substance arising from the rotten trunks of trees has not been sufficiently decomposed to favour vegetation, where it lies in any considerable quantity;* of consequence, it also should be burned, or thinly spread over the soil, after the leaves, &c. have been consumed. The ashes produced by the burning of the log heaps, &c. should be spread over the soil in manner before directed, whether potash be or be not made.

If after the ashes have been spread, the soil be well mixed, as before explained, by the plough and harrow, we shall hear no more complaints of the wild nature of lands recently cleared from their wood.

Where superficial roots abound, the shovel plough far exceeds the long plough for preparing new ground; but not when only about half the ground is ploughed, and the other half covered by the soil, which the shovel spreads on either side of it; this slovenly practice is too general in the back-woods; the farmers in my neighbourhood call it "cut and cover ploughing."

* Even the potato does not prosper well, when planted in an extensive body of this partly decayed, vegetable, powdery matter.

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To use the shovel plough properly, and profitably, the whole of the soil should be regularly cut up the first ploughing; after it has been harrowed, it ought to be properly ploughed again in a contrary direction, and well harrowed; when it has been thus prepared, it will be found in good condition, either for planting fallow crops, or sowing small grain; unless the grounds be filled with fern, dwarf huckleberry, or other small woody plants, having numerous hardy roots, too small to be profitably grubbed up.

In that case, those plants should be mowed off close by the ground, and burned with the other vegetation found in the way; such plants seldom if ever occur in sufficient quantities much in the way, except in thin set woodlands, where but few white or spruce pines, or other trees, having extensive superficial roots, prevail; therefore, the long plough may be most advantageously employed.

The very numerous and hard roots of the small woody plants which prevail in grounds of this description, are often so matted together in flakes, that it requires considerable labour to blend the upper surface of the soil, with the more solid earthy matters under it; especially, as these matted bundles of roots, together with the partly decayed vegetation confined in among them, are dragged up into heaps by the harrow.

Wheat is too often sown on such grounds, by the back-woods Pennsylvania farmer, after they have been only twice ploughed, and well harrowed, and the crop is sometimes good; in general, however, the product obtained by this imperfect cultivation is light; but good crops are often grown on such soils, after they have been three times ploughed, well harrowed, and water furrowed by the plough alone.

It is, however, the best practice, when the clearing can be made in time, to plough grounds of this description in the fall; this exposes the roots of the hardy, woody plants, to winter frosts. After this, wheat, or other winter grain, may be very advantageously grown on them, if they be twice more ploughed, and well harrowed, previous to sowing the seed; if water furrowed, by the plough alone, unless the earthy texture of the soil be very retentive of moisture, and the covering of dead vegetable matters, forming the upper part of it, too thin to keep the texture of it sufficiently open to filter off the water; still there can be but little doubt, that proper water furrowing will, in any case, generally increase the product of the crop considerably.

To produce large crops of maize on such soils as have been described above, they ought to be ploughed in the fall, and twice ploughed and well harrowed in the spring; this can be but too seldom conveniently done by the back-woods farmer; he may, however, grow his maize on such grounds, with but one ploughing; for although the crops cannot in that case be so productive as when the soil is better prepared, they may be good.

When it can be done, it will be far best to plough the ground in the fall, and close the seams between the furrow slices with the tined harrow; this will cause many of the hardy roots of the small woody

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plants to be destroyed by frost, it will also greatly promote an early fermentation. This will prepare more food for the plants, and as time, with rain, the weight of the snow, &c. will have consolidated the open spongy texture of the new soil considerably, the farmer may plant his crop thicker than when the ground is ploughed in the spring; the crop, however, will be a good one, even when the grounds are not ploughed until spring, if the management be proper, and more plants are not introduced than may be well supported by the nutriment arising from the feeble fermentation that will take place in the open texture of a soil filled with hardy roots, which had not been exposed to and injured by the winter's frost. When corn is grown on such grounds, after but one ploughing, done either in the fall or spring, the furrows for planting should be made deep enough to lay the seed on the more solid and earthy soil, and it should be covered not more than one inch deep, with the same material. The plants cannot penetrate a covering, composed principally of hard undecayed vegetable substances, neither does the seed vegetate well under a dry open covering of this kind; it generally rots, or if dripping weather should happen to excite sufficient fermentation to cause the grain to sprout, and the plants are able to penetrate the covering, still, unless the fermentation be kept up by an unusual continuation of moisture and heat, a lack of nutriment causes the plants to spindle, and if they should happen to stand thick on the ground, they turn sallow, and become sickly.

This has induced farmers to believe, that new grounds, like the animals which formerly inhabited them, are wild, and must be tamed before Indian corn can be profitably grown on them; they therefore grow other crops, until the grounds become tame and manageable; wheat and rye are commonly grown to effect this purpose.

The true state of the case, however, is simply this: wheat or rye is not any thing like so readily injured as corn by that lack of moisture and heat which proves insufficient to promote a very profitable vegetation. If they should happen to lie long in the soil without coming up, the rains and snows, which seldom fail to fall late in autumn and early in the spring, generally cause a considerable proportion to vegetate and come up even after they have lain all the winter in the earth without any appearance of vegetation above the soil. As the soil is continually becoming more compact until the wheat and rye is perfected, fermentation and the nutritive matters arising from this interesting process of nature, are also gradually increased, and profitably applied at the time they are most wanted; to wit, when the plants are forming and filling their grain.

As maize planted after the winter grain in the more compact soil seldom fails to prosper, unless the grounds have been too much exhausted, (which by the by very generally happens,) the farmer is confirmed in his erroneous opinion that grounds recently cleared from their wood are too *wild* to grow profitable crops of corn: when, in fact the cultivation of that plant is exactly calculated to

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prepare the soil for small grain; by consolidating the loose texture of it, and by this means promoting the decomposition of the hard vegetable substances contained in it; also by destroying the sprouts and roots of hardy plants, which never fail of producing an extensive growth of very injurious vegetation, unless it be kept under by the tedious and expensive practice of hand weeding. As, however, the slovenly farming in the back-woods has compelled the cultivator to encounter the tedious task of hand weeding rather than lose his crops of small grain, it is wonderful to see with how much patience and resignation he will perform it. It would, however, seem, as his horses are idle while he is doing this tedious work, that it would cost him far less labour to cultivate the soil properly previously to sowing the small grain: but it will be difficult to convince him of this, as he has been accustomed to do the one, and to leave the other undone.

But to return. After the corn has been planted as above directed, the soil and roots removed by making the furrows for planting should be returned into them, taking care to place the roots of the small woody plants uppermost; also not to cover the clusters of seed with them. If this method be pursued, and the grounds are properly turned, and the seams between the furrow slices well closed by the harrow previously to planting, the crop will prosper, provided it be superficially cultivated by the hoe and tined harrow.

It is probable that placing the seed so far below the surface, (especially if the partly decayed vegetable substances happen to run deep,) will compel the plants to form a new set of roots after the hollows formed by the clusters of seed have been filled up by the superficial cultivation of the plants.* This injury, however, cannot be readily avoided without encountering the far greater evil of planting the seed on the hard vegetable matters, and covering it, at least in part, with the same materials.

When the seed is laid on the earthy and more solid soil, the finger roots will dip deep into it and convey much moisture to the plants. The lateral roots, that dip deepest, will also derive much advantage from the earthy texture of the firmer soil. If the lateral roots of plants be attentively examined, it is readily seen, that fibres or roots growing from the under sides of them dip considerably deeper into the soil than those growing out from that part of the root lying nearer to the surface of the ground.† The moisture arising from the earth below will keep the partly decayed and hard vegetable substances lying above it vastly more moist than could possibly happen if these substances were turned up by the

* The injury is much less when the plants are compelled to form a new set of roots while they are very young; especially as this will interfere but little, if any, with their forming prop roots at the proper time.

† This is a wise provision of nature, as those roots are well calculated to gather in a dry time much moisture, far below the range of those that grow in horizontal directions. The structure of these roots is most readily seen when spruce, or white pine, or other trees with superficial roots, are blown down.

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plough and exposed to the drying influence of the sun and air every time the crop is cultivated: therefore, the fermentation and decomposition of these matters will supply sufficient nutriment for the crop of corn unless too many plants be suffered to stand on the ground.

Very close planting should not be practised on new soils containing much dried and hard vegetable substances. The nature and texture of them is such that a decomposition of sufficient nutritive matters is not to be expected in time to grow a very heavy crop of maize. The number of corn plants, however, may be considerably increased if the farmer can get the grounds ploughed in the fall and the seams between the furrow slices well closed with the harrow. The winter rains and snows, together with time, will consolidate the open texture of such soils, and the frost will kill many of the roots of the hardy vegetation. This will greatly promote fermentation in the spring. Lime might be very advantageously employed on such grounds, but it too seldom happens that the back-woods farmer's capital will admit the use of it.

When wheat is sown for a first crop on grounds recently cleared, barley, oats, or rye, may be advantageously grown after it: provided the soil be well cultivated by the hoe and tined harrow following it, or by the shovel plough and tined harrow, (where superficial roots of trees abound,) previously to sowing the seed.

Grass seeds should be sown on the second cultivated crop, unless the soil be deep and rich. In that case, three cultivated crops may be safely taken before the grounds are laid down in grass.

Inconsiderate and avaricious farmers will consider this number of cultivated crops far short of what ought to be grown before the grounds are laid down in grass. Their ultimate prosperity, however, greatly depends on this pivot: yet it seems probable that habit, and deep rooted prejudice, will turn the scale against common sense and observation. But they should recollect, if the soil be too much exhausted to produce luxuriant crops of the grasses, it cannot be fully replenished with their roots, or the animal matters introduced by the agency of their roots and tops; that notwithstanding gypsum will stimulate the soil to produce good crops of red clover, if this grass be sown, yet this is effected by the hasty and unnatural decomposition of the animal and vegetable matters found in it: therefore, the land is still further exhausted by this speedy process of obtaining nutriment from it. No question, however, if this practice be properly ordered, but it will, in time, restore to the land what it had lost by the application of the stimulating manure, with redoubled interest: still, the crops are curtailed until the soil has regained its original fertility. Every waggoner knows full well, that no extra gain obtained by working his horses too hard, will repay him for the loss he must sustain in consequence of this injudicious management. He also knows, that unless his horses be properly fed, they cannot be profitable to him. Farmers do not, however, so soon see, or severely feel, the evil arising from

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working their land too hard, or starving it. They, therefore, appear to think but little of the ruinous consequence, until it is too late. Neither is it to be expected that they will give due attention to this interesting subject, until they become better acquainted with the great analogy there is between plants and animals: also, learn that plants subsist on the same food as man, and that no other substances, except animal and vegetable matters, furnish any nutriment for either.

Here it is considered proper to remark, that it commonly happens that either the roots from the grubs, which are left behind when the grub is removed, or the small roots proceeding from the larger roots of the trees, or the roots of the small woody plants mentioned above, generally fill the upper part of the soil with so many obstacles to regular and good ploughing, as to render it very difficult, and sometimes impossible, to turn the furrow slices even tolerably well.

Were it not that these obstacles, or large superficial roots generally obtain, one ploughing, with the proper use of the hoe and tined harrow, would prepare a new soil, where stumps or girdled timber were not too thickly set on the ground, far better than the practice which has been recommended; provided the timber be of those kinds which do not form large superficial roots, and the ploughman understands his business, and keeps his implements sharp, and otherwise in good condition. When new grounds may be cultivated in this way, they should be ploughed deep to turn up at least two inches of the more solid earthy soil, to be incorporated by the hoe and tined harrows with a moderate proportion of the more open and spongy soil underneath it. This will form an excellent preparation either for planting or sowing any cultivated crop. The cultivator, however, should not forget, that if it be practicable, the grounds ought to be ploughed in the fall, for reasons which have been assigned.

Before I conclude this interesting subject, it is considered proper to remark, that grasses will vegetate much better, and produce more abundantly, in a new soil, where a sufficiency of compact earthy soil has been introduced, by a proper cultivation, than they will do when a new soil has been only superficially ploughed, or scratched, for the growth of the small grain on which the grass seeds are sown.

I have seen grass seeds fail almost entirely, except in the cleaning out furrows, from no other cause than the loose, open, spongy texture of the new land, in which little or no firm, earthy soil appeared; although this soil was not, in general, more than plough deep, and laid on a body of very compact potter's clay, which is well known to be very retentive of moisture.

Notwithstanding wheat is generally a sure crop, when it is grown on grounds recently cleared from their wood, which have been only superficially ploughed or scratched, I have never seen the product any thing like as great as on the same description of grounds, properly prepared.

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The cause is evident. First, the texture of such soils is not calculated to promote the extensive prosperity of grain plants. Secondly, in new settlements, the inequalities in the surface of the soil, have not been leveled by frequent cultivation: therefore, there are, in most fields, a number of hollow places. Notwithstanding the texture of the new soil is well calculated to filter off the superfluous moisture, where the form of the surface will admit it to be done, the water lodges in the hollows, and the winter grain growing in them is destroyed through the winter or early part of the spring. If spring crops be planted or sown, the plants standing in these hollow places are either killed or sadly injured, by an excess of moisture, and the action of heat on it; or by the absence of sufficient heat and an excess of moisture. It should also be observed that even the Yankee practice does not prevent the same serious injuries arising from water confined in these hollow places. In fact, nothing short of proper water furrowing can remove this evil effectually.

To cast further light, however, on this subject of new lands, I will transcribe my letter to Dr. James Mease.

"Dear Sir: I have received your's, covering the pamphlet 'On the Choice of New Lands.' I might refer you to my book on Manures and Vegetation for an explanation of the causes which produced the effects that took place in the vale of Tinmouth. As the subject, however, is highly important, and seems to have been entirely misunderstood, I beg leave to make some remarks on it.

"The writer represents the plains of Tinmouth as 'a beautiful vale, bounded on three sides by exceeding high hills or mountains. The surface, from one to three miles wide, has a gentle slope towards the centre. These plains were originally covered with an immense growth of maple, beech, birch, ash, elm, basswood, &c. and had a coat of *muck*, from six to twelve inches deep: 'deep as heart could wish.' Since my remembrance, this ground yielded great crops of wheat. But then it must be remembered, that *vegetable mould* is not *black muck*, which has been only semi-putrefied. A hard pan would occupy the very surface, but for a downy covering of a bed of leaves, deposited by successive ages from the forest trees, and which are yet, none of them, entirely rotten.'*

"Now nothing can be more obvious, than that valleys bounded by high hills or mountains, are principally indebted to the annual depositions, made by ages, from those hills or mountains, for the very deep covering of vegetable and animal† matters, which commonly prevail in them. It is also equally evident, that no man in his sober senses can believe, that 'none of the leaves deposited, by a succession of ages, from the forest trees, are yet entirely rotten.' Especial-

* See Pamphlet, pages 3, 4.

† It has been explained, in my book on Manures and Vegetation, how nature accumulates animal as well as vegetable matters, in soils managed by her.

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ly, as it would have been very difficult for nature to have placed them in any situation more favourable to fermentation and decomposition.

"But here I would ask how it happened that this immense body of timber could exist so long, and attain so astonishing a size, if the 'black muck, or leaves, remained for ages not yet entirely rotten?' Particularly as it would appear that after the 'muck' had been eradicated, as far as it could well be done by cropping, the grounds were incapable of supporting a tolerable growth of the plants commonly cultivated by us. Although this gentleman tells us that for the first five or ten years, no fields produced better crops of wheat.*

"He says, however, 'Trees may grow to a great height and enormous bulk on such lands, because their roots can penetrate hard masses, and extend to great depths and distances.' No nutritious matters can be gathered by extending their roots to great depths and distances into the hard inert earth, where no food for plants is to be found. The only advantage to be derived by extending their roots into the inert earth, is that of gathering a plentiful supply of moisture, especially in a dry time, and conveying it to the roots and other parts of the plant which are situated where the food for plants obtains; by this means invigorating the upper structure of the plant, so that it may be better able to gather and convey animal and vegetable matters throughout the general system.† For it may be laid down as a maxim in the economy of plants and animals, that no other substances but decomposable animal and vegetable matters, are capable of sustaining animal and vegetable life.

"Nature, however, seems to have taught the roots of trees not to dip too deep into the hard impervious substratum of retentive soils, where it is impossible for nutritive matters either to sink or enter. We therefore see that the lateral roots of trees grow nearer or further from the surface, in proportion as more or less humidity abounds, and that where it greatly prevails, they grow partly within and partly above the ground, as if it were impossible for them to live when enveloped by a great excess of moisture. The taproots of trees also accommodate themselves to the ground. If it be retentive, they grow but a little way into it: if it be very wet, no taproot is seen when the trees are blown up by the roots.

"The kinds of timber growing on the plains of Tinmouth, determined that the soil would be too wet for winter grain, after the animal and vegetable matters abounding in it, when the grounds were first cleared from their wood, had been considerably exhausted. This gentleman, however, is greatly mistaken in saying "The oak will not succeed there, and if planted, would grow shrubby and dwarfish.‡ The black, and some other oaks do not succeed in reten-

* See Pamphlet, page 6.

† This is seen when lucerne is seen growing in a dry climate and soil. It continues green and luxuriant while plants, whose roots do not extend so deep into the inert earth, are parched up with drought.

‡ See Pamphlet, page 2.

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tive soils, but various other oaks do; and it is by no means improbable that red and white oaks were once the prevailing timber on the vale of Tinmouth, as they grow to an enormous size on grounds of the same description.

"In some parts of the neighbourhood where I reside, red and white oak attain a very large size, and are with white and spruce pine, the sugar tree and other maple, the generally prevailing timber on a great extent of country here. We, however, see the scattering trees of beech, birch, basswood and elm, in sufficient number to render it highly probable that these kinds of trees were once the prevailing timber here: also that by the time the soil becomes tired of growing the present prevailing timber, these thinly scattered trees will have furnished a sufficiency of seed to cause them again to prevail. It is, however, evident that a growth of one of these kinds of trees, has been effected on about ten acres of ground, two miles from the town. A man, not long after the settlement was formed, set fire to the soil in a very dry time. Being very deep and rich, it burned like tinder. The fire run so deep underneath the superficial roots of the white and spruce pines, which were then the prevailing timber, that the winds in a short time caused them to fall to the ground, where they are yet lying in great numbers. The consequence has been a luxuriant growth of birch and the aspen tree: some of which are now thirty feet high. Be the changes in timber and other vegetation, what they may, nothing seems to be more evident than that nature when the change is made, is careful to introduce such new plants as are congenial with the soil and climate.

"There are millions of acres of very valuable land in the United States; especially on the high lands, and in the higher latitudes, which, notwithstanding they are found dry enough for winter grain, and great crops are grown on them, when they are first cleared from their wood, become entirely too wet for crops of this description, after the animal and vegetable matters originally contained in them, have been greatly exhausted by ploughing and cropping. Some of these lands are covered with very large timber thickly set together. But there are also very extensive forests which are thinly covered with small white and other oak trees, and as scantily covered with leaves and other vegetable matters, as they are with timber.

"Any of these grounds, however, with but little care and attention in the management of them, would for ever continue to grow as valuable crops of winter grain as any of the soils cultivated by us.

"Yet this gentleman tells us '*Vegetable mould* is not *black muck*, which has been only semi-putrified, owing to a want of sufficient heat in the soil. This want of heat in the soil and subsoil, and the strata underneath, are defective and unfriendly to vegetation. Trees may grow to a great height and enormous bulk on such land. But all the varieties of grain require a warm soil; and the best artificial grasses are far better, either as pasture or hay, grown on soils warm and dry enough for grain. Whenever then in a new

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country we find an accumulation of muck, we may rest assured the earth is of a cold nature; and whenever the muck is worn out we cannot expect to succeed well, in growing any kind of grain.'*

"Now here I would first ask, whether we can rationally expect 'to succeed well in growing any kind of grain,' after the soil has been 'worn out,' be the texture of it what it may? Secondly, I would inquire how happened it 'that for the first five or ten years, no fields produced finer crops of wheat,' than did the plains or Tinmouth. For five to ten years, enough of this 'black muck,' on as I should call it, animal and vegetable matters, remained in the soil, to filter off the superabundance of moisture, and also to communicate sufficient health and vigour to the plants, to enable them to withstand the action of severe frost, through the winter and early part of the spring, which at those trying seasons, proves so destructive to grain sown in the fall, when growing on retentive grounds where a sufficiency of nutritive matter does not obtain. We may, therefore, justly conclude that if the cultivators of the plains of Tinmouth had been as careful as nature was, while the grounds were solely managed by her, to keep them as well stored with animal and vegetable matters as she did, we should have heard no complaint against the wet, cold, and retentive texture of this invaluable soil.

"It is, however, too well known to be controverted, that the settlers of new countries commonly continue ploughing and cropping, with but little attention to grass or manure, until the soil is so much reduced as to be incapable of producing valuable crops.

"Where a happy mixture of the different earths prevails, no obstacle but absolute poverty can be presented to the growth of plants: consequently, such a soil, if equally rich in the beginning, will bear ploughing and cropping longer than soils which are either retentive of moisture or abound in sand. We, therefore, hear loud complaints as soon as the farmer has reduced his grounds so much, that an excess of clay or other impervious substances oppose an excess of moisture, or sand a deficiency of it, to the growth of his cultivated crops.

"This outcry is often raised against soils in the high lands, or higher latitudes, where an excess of moisture commonly prevails, while there still remains enough of animal and vegetable matters in the soil, when assisted by the natural humidity of it, and of the climate, to grow tolerable crops of the grasses. Hence it is, that the farmers in the vale of Tinmouth still 'say, they have a good grass soil.'† This is evidently seen here, in some of our highest, but still retentive grounds. After being so much exhausted by ploughing and cropping, as not to be capable of producing more than six or seven bushels to the acre of wheat sown in the fall, they have yielded tolerable crops of timothy when laid down in that grass. Now these very lands produced formerly good crops of wheat sown

* See Pamphlet, page 2. † Idem, page 5.

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in the fall, and no question but they would have continued to do so still, if they had been properly farmed.

"From what has been advanced, it would appear, that nature has rendered cold, retentive clay, and also sandy soils, when they are kept well stored with animal and vegetable matters, quite as fertile, and in fact more so, for the growth of such plants as are congenial with their texture, than is that happy mixture of the different earthy ingredients which seems to be favourable to every plant, but not particularly so to any one of them. Nature certainly had something in view when she created such a diversity of soils, as they might have been all readily formed with one uniform texture.* Why, then, should we complain against the earthy texture of any soil when it is evident that soils of every texture are fertile, unless too much or too little animal and vegetable matters are mixed with them? In either case the remedy is obvious, but in the latter case much more labour and attention are necessary to supply the deficiency. When this deficiency, however, has been introduced by an irrational system of management, as certainly happened in the plains of Tinmouth, there can be no just cause for complaint.

"But so little did the writer of this essay seem to know of the most simple, but at the same time, highly important operations of nature, that he says, 'it would be *curious* and useful if some *philosophical* observer would *explain* the entire disappearance of this *muck* in the course of fifteen or twenty years without leaving a residuum. Twenty-five years ago, I ploughed fields on the Tinmouth plains which had then a covering of six inches or more of this muck, and they had been cropped some ten or twelve years: these fields have now not one particle of *muck* or mould! What has become of it?'

"The answer to this question is so very obvious that it really seems wonderful how the writer could attach so much consequence to it. The decomposable animal and vegetable matters contained in the 'muck' were consumed by the plants grown on the grounds, and the residuum mixed with the soil.†

"I will conclude with remarking that those 'six inches or more of muck,' or, as I should call it, of animal and vegetable matters found in those grounds after 'they had been cropped ten or twelve years,' clearly determines that their fertility might have been very easily preserved for ever, and that in place of hearing any complaint against the earthy texture of the plains of Tinmouth they might have been at this time justly considered among the most fertile lands in the State of Vermont. There is no art more simple than agriculture: still none seems to be more imperfectly under-

* Why this great diversity of soils exists has been explained in my book on Manures and Vegetation.

† This residuum, however, must have been very inconsiderable, as the substances contained in the muck which were calculated to prepare the food for plants and to form their structure were also consumed by them.

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stood. The cause of this is evident. Farmers have been very much bewildered by various inconsiderate and irrational theories; none of which seems to have been more extensively injurious than that chemists, philosophers and farmers have informed us, that nutriment for plants exists in substances which merely excite fertility by a hasty decomposition of the decomposable animal and vegetable matters found in the soil. These stimulating substances cannot, however, be permanently useful to agriculture, unless a due proportion of the vegetation excited by them be returned to the land.

"I hope you will excuse the length of this communication, as the little I have yet to say, added to what has been already advanced, will be, if acted on, of more consequence to the agricultural interests of Vermont, and the other eastern States, than can be readily imagined.

"These States, like the Alleghany mountain, on which I have resided six years, present very serious obstacles to the growth of grain sown in the fall. Excessive cold and humidity kill the plants, when grown on soils, where a sufficiency of decomposable animal and vegetable matters does not obtain, to render the system, and the organization of the plants robust and perfect. Plants, like animals, cannot live, when exposed to the vicissitudes of the severe inclemency of those climates, after being starved and debilitated: especially when confined where but little food can be obtained. Hence it is, that in those States, as well as here, spring wheat will succeed, so far as to produce tolerable crops, where wheat sown in the fall fails.

"I am, however, willing to risk my reputation as a farmer, and a man of truth, if grain sown in the fall does not prosper on the Alleghany mountain, and in the eastern States, as well as it does any where else: provided a sufficiency of animal and vegetable matters be judiciously applied, the soil properly cultivated, enough of seed sown, and the plants be laid dry, by properly water furrowing the land. I have seen this so often tried, where wheat sown in the fall could no longer prosper, in consequence of the animal and vegetable matters formerly contained in the soil, being too much exhausted for the plants to find sufficient food to feed upon, that I cannot be mistaken."

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CHAPTER XXXV.

On barns, cattle sheds, barracks, and hay savers. On the different ways by which cattle are fed and sheltered through the winter.

Enough has been already said on expensive barns and dwelling houses. The best mode of forming and conducting cattle yards has been also explained.

A small barn is necessary, for threshing and various other purposes. It costs but little labour or money to erect a barn without the aid of a nail, or a particle of iron, where timber is a drug, if light round timber be selected for the logs that form the walls. This course, therefore, should be invariably pursued in recent settlements, where labour, as well as money, is scarce. If such barns be properly constructed, with durable wood, they will last a long time; provided the building be set high enough from the ground, and be underpinned with a wall of stone, which is readily laid by any man, without mortar. If the underpinning, however, be not sunk to a solid foundation, the house will sink, and the undermost logs rot in a very short time. This is the reason why log houses are reprobated. They are generally set on blocks of wood. These sink, and soon hasten into decay. The house sinks with them, and the undermost logs, sleepers, and floor, soon share the same fate. When this happens, the farmer says a log house is good for nothing, although the fault lies in him, and not in the house. I am now living in a log house, built with white pine, about twenty-four years ago. It was set on blocks, and not far from the ground. The first logs, sleepers, &c. were so much decayed that I was obliged to remove the logs, and put others in their place. The remainder of the house is perfectly sound, and seems as if it might last a very long time. Now I do not know a single house, but one, built in the settlement, previously to my removal to it, which was not set on blocks of wood; of consequence, the under parts of most of them are now rotten.

Barns are so generally well constructed in our older settlements that it would be superfluous to suggest any improvement in them. The useless ornaments and expensive materials, however, which have been introduced by some gentlemen, ought to be avoided by all who wish to establish the simple principles of genuine rural economy. The farmer's pride should rest in the display of luxuriant crops, obtained with the least possible expense: especially, if he be very rich, as his example might go very far towards turning the tide of vanity into its proper channel.

Barracks, when properly constructed, preserve either hay or grain quite as well as barns, and the latter much better, so far as the de-

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predations committed by rats and mice are concerned. Some gentlemen believe that grain is not so subject to become mouldy, or otherwise damaged, even in stacks, if they be well thatched, as it is in barns. They say the superfluous moisture escapes more freely from the former. Be this, however, as it may, it is evident that both hay and grain may be very advantageously and safely kept in barracks, if they be properly constructed and well thatched.

When the roof is made to slide up and down, it leaks at the corners, and without great care, is soon wrecked to pieces. When the posts stand in the ground they rot too soon. If mortised into sills the water gets into the mortise, and produces speedy decay. They are much more lasting when the posts stand on broad stones, thick enough to project six or eight inches above the ground, after being sunk deep enough into it to lie on a solid foundation.

I have had them made thirty-six feet long, twenty feet wide, and twenty-two feet high, measuring up to the top of the upper plate. These require four posts on each side, set twelve feet apart. They are mortised into the two side plates: four joists extend across the top of the barrack, directly over the tops of the posts. These are notched, so as to let in the plates. Those at the ends answer in the place of plates. The posts are bound together by plates mortised into them, about ten feet below the upper plates along the sides and across the ends of the barracks, and also from post to post across the interior of it, at the same distance below the upper plate. Two braces extend from each post, up to the upper plates, and to the upper joist that extends across the ends, and one brace is extended from each post to the joist which extends across the top of the interior part of the barrack. The same number of braces are extended from the posts up to the lower plates and joist, which bind the sides, end, and middle of the barrack together. The braces are dovetailed into the posts, plates, &c. and spiked fast to them; as the labour is less than if they were mortised and tenoned. It was also thought the water would be less subject to lodge, and they would be less liable to rot when put up in this way. The pitch of the roof is formed to close the ends, as the winds will affect the top of the barrack much less than if the gable ends were boarded up. The roof is thatched with rye or wheat straw. If this be properly done, it will last a long time, and be very valuable for littering the cattle yard when a new cover becomes necessary. Any farmer who can handle common tools will soon erect such a barrack from the stump. But where timber is valuable it should be all sawed.

A barrack of this size will store twenty tons of hay, or perhaps more. In a well settled mow, when not so high as this, eight feet square, or five hundred and twelve cubic feet will weigh a ton. It will require more cubic feet, at and near the top of the mow, to weigh a ton, but less are found sufficient at or near the bottom. The bottom may be formed of any kind of poles, split timber, or boards. It should, however, be raised a little distance from the ground, either by stones or timber. This will permit the moisture arising

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from the earth to escape. If this be confined, it will damage the bottom of the mow: it will also admit the cats to pass underneath it.

If the barrack is intended for storing grain, the farmer should extend very strong joice across it, from post to post, two and a half feet above the level of the ground. The post ought to be capped just below the joists, in the way that will be described when the proper construction of a corn crib is explained. If this be properly done, no rat or mouse can get in among the grain unless carelessness furnish the means for them to climb up into it. As the joists will be few, they ought to be let into the posts, so that the ends may have a bearing on the solid wood, otherwise the weight of the grain would break off the tenons.

Some English farmers exclude mice and rats from their grain stacks by erecting them on foundations or pillars made of cast iron, stone, or wood work properly capped: still, they have not been able to exclude them from their barns. The frequent intercourse of labourers renders it impossible to guard the doors so that these intruders cannot find an opportunity to enter. After they get in, the contents stored in the building seldom fail to furnish them with food and a secure retreat. The patient vigilance of the cat, however, will pursue and destroy them, if that animal be properly managed.

When hay or grain is put into the barrack, the first twelve feet between the posts should be first filled quite up to the top of it. After this the second and then the third divisions between the posts ought to be filled up in the same way. If the whole extent be regularly filled damage may arise from driving rains before the barrack is filled; and the joists running across the interior of it will hinder the hay or grain from settling properly. The hay should be removed by cutting a small portion of it regularly from the top to the bottom, beginning at one end of the barrack. The grain should also be taken out by hand in the same way or damage may happen from driving rains or snows. If attention be given when the grain is put into the barrack it may be readily mowed so as to favour the proper removal of it. If the waggon cover be spread in the bed of the waggon when the grain is removed to the threshing floor but little will be lost if it be carefully loaded.

When labourers are scarce, or the weather is dripping, it is often found difficult to get the hay and grain hauled from distant fields and secured in time: therefore serious losses sometimes arise from these causes alone. The extra wages and liquors during harvest also increase the expense of a distant removal of the hay and grain. We likewise too often hear of extensive losses arising from fire being communicated in various ways to the combustible substances in and about the barns.

It would seem that if barracks were erected on such different parts of the farm as would generally most favour the inning of the hay and grain, the time of harvest would be considerably shortened, and the risk from wet weather greatly abridged. The whole

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of the produce would not be subjected to one sweeping loss if fire should happen to take place. Be this, however, as it may, I can safely advise the farmer to place his barn yard establishment so far distant from his dwelling that if the one should take fire the other in all probability might be saved.

Here I beg to observe, that I have thought forming the barrack only sixteen feet high to the top of the upper plate would be a better plan than that adopted by me. One set of longer braces without any plates along the sides and ends or across the middle of the barrack would in this case be sufficient. The labour would be considerably abridged, and less injury from decay, as fewer places would be formed for water to lodge in. Those for storing grain might in this case be nineteen feet up to the top of the plate, as the joists running across them two feet and a half above the level of the ground would greatly strengthen the lower parts of them.

Cattle and horses may be kept tied up in close stables without any apparent injury to them, provided the stalls be kept very clean. Doing this, however, together with keeping the stalls well littered and taking the animals to and from water, is tedious and laborious if it be properly done: especially as when they are confined they are compelled to lie down in their dung. It therefore requires much more labour to keep them clean than when they are suffered to run at large in well littered yards, and have open and well littered sheds provided to screen them from the weather. Some farmers and graziers say that cattle do best when no shelter is provided for them; but of this I am very doubtful. It may, however, answer tolerably well when cattle have been accustomed to it, provided they are suffered to seek shelter for themselves in thickets, &c.: but by this practice the manure is lost. My cattle were injured by keeping them a part of one winter without shelter; but as I wished to save their dung they had no opportunity of seeking shelter for themselves.

Waggoners who travel on the roads will not stable their horses even where it might be done without extra expense. They are hitched to the waggon, and fed and kept there through the most inclement nights, after being heated by the labour of the day: yet if they be well fed and otherwise properly attended we do not perceive that they are injured by this practice: still as every animal when at liberty seeks shelter from the inclemency of the weather, it would seem that the waggoner's practice is not well calculated to promote the health and prosperity of his team, unless it be, that by exposing them uniformly they do not suffer so much as they would do by being occasionally exposed. It therefore appears probable that the middle course between this practice and that of fastening up the animal in a close stable ought to be pursued. The generally prevailing opinion among Pennsylvania farmers, is, that close, warm stables are best.

There are, however, gentlemen of the first agricultural talents who let their best horses run at large in yards where they may at

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pleasure retire under the shelter of proper sheds, provided for that purpose. These gentlemen believe that the health and vigour of their horses are greatly promoted by this practice. We all know that men whose business confines them much to the house, though it may be laborious, are not generally any thing like as healthy as those who are commonly exposed to the open air. It would also seem, that nature never had intended that cattle and horses should be kept closely confined in warm stables.

Sheds are erected with little labour and expense. The back of them forms the cattle yard fence as far as they extend. If the posts be lasting the remainder of the timber may be of almost any kind of scantling or even poles. Sound half price boards will be good enough for the backs and ends of the sheds. I have seen even slabs very advantageously used for this purpose. The roof may be thatched, but unless the eaves be raised rather too high the cattle are apt to pull down the thatch. It is therefore best to extend a broad board lengthwise the eaves of the roof, or two narrower ones to lap, so as to run off the rains and to thatch the rest of the roof. When good thatches cannot be had, thin sound white pine boards will make a lasting and cheap covering for the barracks and sheds.

In my observations on soiling I have described how the floors of the sheds should be formed.

When cattle are kept through the night in stables and fed through the day in yards where no shelter is provided for them, moveable hay savers should be formed with a view to spread the rich manure over the yard, and also to save the hay from waste. Those savers should be four and a half feet wide, the length not exceeding ten or eleven feet. If longer, they will be unhandy to remove. If shorter, corn fodder cut off by the ground cannot be well put into them. The posts ought to be four feet three inches long to form the four corners of the saver. These are to stand erect, and to be united by rails framed into them at the sides and ends. Two rails high all round will be sufficient for holding the hay, provided the top of the uppermost rail be two feet above the ground. The rails should be wide enough to prevent the cattle or horses from pulling out the hay from the vacancy left between them, or from the space left between the bottom rail and the ground.

To prevent the cattle from getting into the savers, rails should be framed in all round, near to the top of the posts, so as to leave eighteen inches between the rails below. This will be wide enough for underlings to extricate their horns speedily when in danger of being injured by their superiors. The whole construction should be light, but strong enough to withstand the exertions of the cattle when contending with each other. A bottom is not requisite, as a little clean straw spread upon the ground when the saver is removed to a fresh spot will be sufficient.

In these, cattle eat immediately over their food without waste. Racks, like many other inventions connected with farming, have

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been generally used from time immemorial, although they do not possess a single advantage. They are costly; and if the rounds are barely wide enough apart for cattle to get out the hay, much of it will be pulled down and trampled under their feet. They compel the cattle to assume an unnatural posture for feeding, even when the front of the rack is vertical. Grazing teaches us the natural posture for cattle and horses to feed at ease to themselves.

This is obtained by using hay savers. Their eyes and nostrils are not affected by the seed and other small particles of the hay, or from the dust and sand, or other injurious substances that may be contained in it. They can readily pick out the hay without being annoyed by briars, weeds and other substances offensive to their feeling or taste.

In stables and under sheds hay savers may be about twenty-seven inches wide. If the floor of the stable be made of wood it may constitute the bottom, if the seams be tight enough to hold short or chopped food. Boards six inches wide may form the front and back; above this, railing will suffice.

By this very economical and expeditious mode of feeding either cattle or horses, the saving in hay is much greater than can be readily imaged by those who have not been in the practice of using savers.

If racks be considered necessary, the saving in the hay will be the same if savers be constructed under them in the stables, and around those in the yards. The latter, with the racks, may be readily constructed so as to be moveable. If a light covering of boards be attached to the savers the hay in the yards will not be injured by rain.

It was soiling that first suggested the idea of hay savers to me. I found that the cattle quickly pulled down under their feet the grass fed to them in the same racks that were used for feeding hay to them. It seems the grass while green is much more slippery than when it is dried into hay.

To prevent this great waste, posts that had been rotted off by the ground were sunk into the earth at proper distances from the four corners of the rack standing in the yards, and common rails inserted in two holes left in each post above the ground for that purpose. As these savers remained until feeding with hay commenced, it was soon observed that the saving in that article by the means of this simple and very cheap contrivance was amazingly great. The horses and cattle ate the hay which they pulled down into the savers as readily as that remaining in the racks. Since that time the savers without the racks have been preferred by me.

Worn out posts, if broad rails be selected, will make the cheapest savers for the sheds, and answer the purpose equally as well as if they had cost the farmer much more labour and money, provided dry fodder or grass alone be fed to the cattle where they are used.

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CHAPTER XXXVI.

Mathematical precision, necessary to a highly improved husbandry.

Random practices in agriculture, have been found sufficient to procure a tolerable, but at the same time, precarious supply of the fruits of the earth. Mathematical precision has, therefore, been too much neglected. Farmers generally ridicule, and violently oppose every essay made by men of reflection, to reduce the practice of husbandry to any regularity, which depends on accurate calculation.

Infinitely more injury, however, has been done by the violent opposition made, not only to the system of the drill husbandry, introduced by Jethro Tull, but also to the improvements that have been made by others, on the inventions of that truly ingenious gentleman. This has been done by gentlemen whose opinions on agricultural subjects were very popular, and whose talents, (if they had not been blinded in the first instance by an inconsiderate prejudice, and secondly, too obstinate to acknowledge error, after it seems to have been clearly seen by them,) were more than sufficient to have discovered that the practice of agriculture can never be perfect, until it be governed by mathematical precision: so far at least, as this may be attainable. The nearer we approach to this only perfect rule of practice, the greater the improvement will be.

The celebrated Arthur Young, in his Rural Economy, is much opposed to the drill husbandry. He seems after this, however, to be clearly convinced of his error, and makes various efforts to back out. This is at best, an awkward retrograde motion. It would have been greatly in favour of agriculture, and would have done honour to himself, if he had boldly wheeled round and candidly acknowledged his mistake: while he was tardily backing out step by step, those who relied on his judgment, could not readily determine what course they ought to take.

It is an old saying, that "guess work is best when it hits right." It can, however, be no otherwise so, than as far it may happen to save expense, and the trouble of rational investigation. It leaves the practitioner nearly, or quite as ignorant of the principles that operated in his favour, as he was before the fortunate occurrence took place. If he be called to explain the means that should be pursued by others to attain the same end, but little, if any, correct information can be obtained from him. This is one powerful reason why it is so exceedingly difficult to communicate agricultural practices, so as to be clearly understood.

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It is the power of mathematical demonstration that ennobles the mind of man. Strip him of this, and he is little superior to the horse he rides or drives. It is by the diligent practice of this natural or inherent principle, that even the illiterate sometimes achieve improvement, that would do honour to the talents of the learned.

No art can be perfectly practised without the aid of exact calculation. There are, however, some of the arts that seem to depend principally for accurate proportion on the imagination, assisted by the senses: still these are but few, when compared with the whole.

Almost every mechanical employment has its measures, gauges, &c. formed by exact mathematical calculation. There is no art that requires more assistance from correct calculation than agriculture, and none that is capable of being more highly improved by it.

We know but little of the proper depth for planting and sowing the different seeds, or of the space which should be allowed for different plants. There can be no doubt, however, that the proper depth and space actually exists in nature. Therefore, if they were known to us, and we possessed proper and ready means of sowing, planting and cultivating with mathematical precision, the produce would very greatly exceed the present general opinion on that subject.

A deficiency of proper instruments renders it impossible to effect this purpose very extensively at present. Still a great deal might be done in these parts of our country, where stumps and other obstacles to a regular system of husbandry do not obtain, and time, with an increased population, will remove the greater part of them.

Agriculturists have already invented several instruments that execute planting, sowing and cultivating many plants with sufficient accuracy. Some of these are simple and cheap enough to render the use of them extensively advantageous, if they were brought into general practice. The form of them is calculated to suggest ideas and plans, from which other instruments may be made for other purposes. One improvement is commonly followed by another. This would, therefore, naturally lead to the construction of instruments, which would enable cultivators to execute all their agricultural purposes with mathematical precision, provided due attention be given to this highly important subject.

The heavy and unwieldy wheel ploughs, which are used by some British cultivators, are very exceptionable. There are, however, other ploughs of this description, that are light and well formed. Notwithstanding the wheel naturally causes some resistance, the trivial disadvantage arising from this, cannot be equal to the immense advantage to be derived from a uniformity in the depth of ploughing; especially as this uniformity makes the weight of the draught regular. This renders it at least very doubtful, whether horses or oxen are even as much jaded by the use of wheels, as they are without. Without them vastly more care and labour are necessary than I have ever seen encountered, even by those who drive their own teams, except for a spirt, to effect a regular depth of ploughing, when

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wheels are not used. In this case the depth too commonly deviates in due proportion to the inequalities which may happen to be in the surface. Thus, when the plough is passing through a hollow spot in the field, it often does but little more than skim the surface; while it too often sinks nearly beam deep when passing through the rise just beyond it. What commonly makes the matter worse, is, that the rising grounds are generally the poorest and the hollows the richest parts of the field. The great deviation in depth, often requires considerable exertions in the cattle to get through; consequently tires and worries them much more than a regular draught.*

Since springs have been introduced to weigh the draught of the plough, and plough races have become fashionable in England, some gentlemen in that country have laid aside their wheel ploughs, to avoid the resistance introduced by the wheel. This may be very proper when racing is the object, as sportsmen tell us, that even a single pound often makes a great difference on such occasions. So far, however, as agriculture is concerned, it seems to be giving up a substantial good, to avoid an evil, which if it does exist at all, is trivial, and which it would appear exists only in the imagination, so far as farming may be concerned.

An expert ploughman, with a well broke pair of horses, will, while he is running one of these races, perform ploughing to a regular depth without the aid of a wheel: still it is not to be expected that he or any other person will daily encounter the excessive labour necessary to plough to a regular depth without a wheel.

In fact, gentlemen of the first agricultural talents in England, say that the best ploughing done in that country is performed where wheel ploughs are used. There are also other very great advantages attached to them. When the wheel plough is well set, an ordinary ploughman can do good work; and even a lazy man has but little temptation to slight his work, as his labour is greatly abridged.

Notwithstanding a regular depth of ploughing is highly important, it is of little consequence when compared with the immense advantages that naturally arise from placing seed at proper depths in the soil, arranging plants at proper distances on it, and introducing such implements of husbandry as are calculated to cultivate them with the least possible expense.

Correct mathematical arrangement in the mechanical arts, has, in numerous instances, simplified and rendered the labour so easy, that a boy or a girl can do much more and better work than was formerly done by an active and well instructed man. We, therefore, have every reason to believe that the same saving of labour would as extensively take place in our agricultural concerns, if care and attention were alike given to introduce the same correct system of management.

* It should be recollected, that if the beam of the plough be uselessly long, which very often happens, and the wheel be fixed too far before the coulter, the sudden rises and hollow places in the field will not be ploughed to a regular depth.

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The American wheat drill seems to be as simple and cheap as it is possible to construct an instrument of this kind. We have no engravers here, therefore a plate of this very valuable instrument, or indeed of any of the other instruments recommended in this work, cannot be annexed. Such observations on them, however, as may be considered useful, will be made. There is a plate of this drill, in the third volume of the Memoirs of the Philadelphia Agricultural Society. It is also described in the "Transactions of the Society of Arts in New York."

I got the one used by me from Downingtown, in this State, where it was made. It is said to have been originally invented in Sussex county, New Jersey. It may be still made there unless it has been laid aside, which is by no means improbable, as I have never heard of the grain sown by it, being either covered or horse hoed, although both may be readily and well done with the same instrument. Towing in drills, without cultivating the plants, will do more harm than good, it is exactly calculated to let in more weeds and confine the roots of the plants too close together, unless those disadvantages be counteracted by a proper cultivation. So, however, it generally happens among farmers. They are certainly as capable of exercising their reason as "any other set of men in the world:" still, they are too apt to believe that agriculture is so well understood by them, that the use of this faculty is seldom necessary in the execution of any of the business connected with it. They should, however, recollect, that notwithstanding the practice of "husbandry" is really very simple, and readily understood, it will most assuredly continue to be, what it has ever yet been, to wit: a mixture of complicated absurdities, which no man can understand, until "nature and reason be harmonized in the practice of it." But to return.

The merit of the wheat drill consists in the simplicity of its construction. The leathern bottom to the seed hopper forms the principal superiority of it. This renders brushes and complication useless. Yet I have not observed that the seed is bruised, or the delivery of it irregular or uncertain. It came to me with a tongue, but finding two horses useless, a pair of old cart shafts were fixed to it. One horse, a man and an active, but small boy were found sufficient to drill at the rate of six acres per day. The boy leads the horse. The man walking behind the drill observes the delivery from the funnels, least any thing accidentally mixed with the seed, should retard or stop the progress of it: also to clear away from the coulters, any rubbish that may gather, when it is likely to stop the funnels. This is best done with a very light handy pole, sharpened at the point, and an upright thumb, formed by a branch cut off near the point. With this instrument and proper attention, the horse need not stop until the through is performed. If an occasional stump happens to be in the way, the drill is readily lifted over this by the man, while the harrow is going on. At the end of each through, the boy turns the horse, while the man, with ease, lifts up the drill bo-

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dily, and sets the wheel in the track of the last formed outside furrow. He at the same time takes care to place it far enough back into the head land, for the grain to have time to run down the funnels and to commence delivery at the proper place. The horse should not be stopped until the through has been performed, as the seed delivered from the axle, previously to stopping, will run down, and the whole will be deposited immediately under the funnels. If an unavoidable accident makes it necessary to stop the horse before the through is performed, the drill must be lifted up, and the horse backed sufficiently for the funnels to commence delivery at the proper place, or there will be a vacancy left unsown.

The person from whom I purchased the drill, thought it would sow more than one bushel to the acre. It was, however found to sow but little more than three pecks per acre. The notches in the axle, were made large enough to sow two bushels per acre.

The farmers who have used this drill, say that the falling in of the soil after the coulters, forms a sufficient covering for the seed; that the mouldering down of the soil through the winter, is beneficial to the crop. In this they are, however, much mistaken. My grounds were level and in fine tilth, yet the trivial inequalities in the surface, were sufficient to prevent some of the coulters from sinking sufficiently deep for the mould to fall into the furrows and cover the grain, while the rest of the coulters went quite deep enough for the soil to fall into the furrows and cover the grain superficially.

A rake attached to the hinder part of the drill, so as to rise and fall, but not to swerve from side to side, will, if properly constructed, cover the seed. The method pursued by me to effect this purpose, was extending a light fence rail across the drills, and dragging it by a horse up and down the lands. This seemed to be awkward work; it was, however, tolerably expeditious, and considered much better than leaving a good deal of the seed entirely uncovered, and exposing the plants to the running, settling and freezing of the water in the drills through the winter, which cannot be otherwise than very injurious to them.

The coulters of this drill were formed of wood, and shod with sheet iron. Yet four of them fixed properly in it, answered every purpose for which they were designed. I had the shanks of four hoes belonging to an old hoe harrow lengthened. These fastened into the mortises in which the coulters were fixed for forming the drills, answered well for horse hoeing the grain plants.

It was found very easy to regulate the hoes so that they would either skim the surface of the soil, or cultivate it much deeper than prudence would suggest. The horse in walking, straddles one of the rows of wheat: a man leading him will horse hoe more acres per day than he could drill with the same tool. Some clods and stones will be turned on the plants, therefore labourers should follow to remove the obstacles, and pull up such weeds and grasses, as may happen to grow among the plants. A proper rake should be

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fixed to the hinder part of the drill, in the way that has been described above, to overturn and destroy such weeds as the hoes may have cut off under the soil, but which had not been overturned or sufficiently mangled by them.

The grass seeds should be sown just before the last horse hoeing, and the rake attached to the drill will cover them effectually. The hoes should not be suffered to dip any deeper than is absolutely necessary to eradicate grasses and weeds. The cultivations ought to cease before the plants become large.

A triangular form is best for the hoes; the coulters to which they are attached should be sharp in front and point. If this drill is made by a plough maker, it ought not to cost as much as a common swing plough. Any farmer, however, who can use tools tolerably, may make it for himself, if he first gets the axle turned true, out of hard seasoned wood, which will not spring. The funnels are commonly made of wood or sole leather; tin, however, is much better, as the grain is heard running down it, and being smooth, the grain is not so liable to be stopped in its progress.

Here I ought to observe, that water furrows should be formed at proper distances by the common plough, previously to the drilling of the seed. If this be not done, heavy rains and melting snows will greatly wash away the soil and plants with it. If cross furrows be found necessary in low places, hollows or hill sides, they should be formed immediately after the seed is drilled by the long plough, and also opened by the same instrument every time the plants are cultivated and regulated by manual labour, so that the water will stop in no part of them.

I beg leave to observe, that maize, beans, &c. may be readily dropped in clusters at any desirable distance apart, in rows, by an instrument of the same simple construction as the drill just mentioned, also, covered by a rake, formed so as to effect this purpose, without displacing the seed. In that case the wheels ought to be very low, and neither funnels nor any other thing should intervene to prevent the grain from dropping immediately from the notches in the axle, into the furrows formed by the coulters for the reception of it.

An instrument may also be readily formed on the same principles, for striking out with great despatch, narrow right angles, with furrows formed in them for planting.

Mr. Bordley certainly invented, and reduced to practice, a very simple and cheap machine for dropping beans, and another for dropping wheat in clusters. Except the leathern bottom to the seed hopper, (which is a very great improvement,) the principles seem to have been much the same, as those on which the wheat drill is formed.

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CHAPTER XXXVII.

On the hoe harrow. A simple gauge for dropping corn, beans, &c. in clusters. On the corn crib. On the shovel plough. On the skim.

The hoe harrow is formed triangularly, and should have handles: the smaller size ought to have three triangular hoes, supported by coulters, sharp in front and point; and five for the larger size. They should be so formed and fixed as to effectually cut all the ground to the extent of their spread.

If wheels be added, they will insure any desirable depth with perfect regularity, and very great ease to those who use them. The wheels may be readily made with thick hard plank, dubbed so as to form naves and rims. When the cultivator, however, can spare the money, it will be found far best to have proper light wheels with spokes and boxes, and shod with iron, as they will be more readily handled, and last much longer.

Implements of this description, and sometimes very expensively formed, are extensively used by some British farmers: if my memory be correct, they are called shufflers or cultivators. This excess in size, however, should be avoided by us; they spread over too much ground to effect good cultivation in the uneven surface of what may, in any country, be justly considered very level fields. In fact, nothing is gained by aiming to do more, than can be properly executed.

The wide spread of common harrows, united together by joints, intended to calculate them to rise and fall, so as to move in unison with the inequalities of the surface, is a burlesque on common sense; especially, as the plates furnish correct engravings of the contrivances made to hitch double sets of horses to different parts of this unwieldly mass of absurd and ineffectual complication; which, to be the better explained, has the track of each tooth carefully lined and numbered, with elaborate notes of explanation and observation on the very superior usefulness and great expedition of the implement.

Now as two waggons fastened side by side pretty much in the same way, and furnished with double sets of horses, will certainly carry a much heavier load than one waggon, with only one set of horses. I do not see why we ought not to be furnished, also, with an engraving of this improvement, and with an exact description of all its very advantageous movements.

Time and memory fail me, or I would expose the vast number of complicated, expensive and highly injurious contrivances which have been published, and warmly recommended to farmers.

It is these things which have induced the plain and practical far-

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mer to set his face against even real improvement that has the least appearance of complication attached to it.

Complication generally introduces weakness; it has, therefore, been powerfully urged by Arthur Young, and other opposers to the drill husbandry, in England, that such complicated instruments were unfit to be put into the hands of rugged and inconsiderate workmen, who would soon break them to pieces. The engraving and description of the wheat drills used in England, seem to be very complicated and expensive. Time, however, has convinced many farmers there, that this expensive complication does not hinder them from being safely and very advantageously used.

It would seem as if complication and expense had been studiously avoided in the American drill; still all its parts, at first sight, appear to be sufficiently strong except the wheels. The construction of them seems to indicate that the inventor either knew that the apparent weakness of them, would not prevent the usefulness of the instrument, or false economy governed his practice in the formation of them; they are made little stronger than the big wheel commonly used for spinning cotton and wool, and much in the same way, without any iron to defend the rim.

The plough used by me, however, had been several years in use at Downingtown, before I purchased it, and the owner of it informed me that his grounds were rather stony for drilling. I believe, however, that it would be best to form the rim of the wheel with iron, in place of a wooden hoop, and that some of the other parts of the plough are heavier than necessary. Here I beg leave, however, to remark, that any material deviation from the cheap mode of constructing this instrument, cannot fail of being very injurious to the interest of agriculture. For as it now stands, every farmer who wishes to use it, can, without any serious inconvenience, either make or obtain it. Therefore, gentlemen farmers should be very careful not to saddle this invaluable instrument, with expensive improvements.

A simple gauge for dropping corn, beans, &c. in clusters, may be made thus: cut an alder stock of about one inch in diameter, just below a limb, which will serve for a handle; hollow it out above to hold the number of grains to be dropped in each cluster, paring the upper edge thin, so that the grain will not lodge on it. With this, and a small basket, a little boy or girl, may drop three times more clusters than a man in the usual way, and more correctly. It is better to scatter the seed a little; when this is done, birds and quadrupeds do not so readily get the whole from any one cluster, as when they lie close together, and the supernumerary plants are pulled up, the roots of those which remain, are not so much injured by this operation; neither are the plants that ought to remain any thing like as apt to be pulled up with those which are removed, as their roots will be less entwined. They also grow faster, by being only a little separated from each other; especially if the whole of the seed should happen to vegetate and come up. Beans, as well as maize,

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are subject to be cut off by the grub: they, therefore, should not be thinned until after danger from this intruder has passed by.

I can suggest no improvement in the form of our best constructed corn cribs, when built in a dry climate, except that too many take no effectual measures to exclude rats and mice. After these intruders get in, they find a plenty of food and shelter from their pursuers, until the corn is removed.

To determine the number of bushels which any given space will contain; first, calculate the number of cubic feet, from which deduct one fifth, and the remainder will be the number of bushels; at least near enough to show the size of the crib. As corn, however, shrinks considerably in the crib, especially in high latitudes, where it very often carries in much moisture with it, a proper allowance ought to be made for this.

In high latitudes the building should be wide enough to admit a passage through the middle of it, with a crib for the corn on each side of it. Those ought not, on any consideration, to be wider than three feet in the clear. They ought to maintain the same width from the bottom to the top of them. The height of them up to the top of the building, may be seven or eight feet above the floor. The lathing for the outside should not be more than one inch and a quarter or one inch and a half wide, and the distance between as wide as it may be left consistent with excluding such birds as are in some situations, apt to get into cribs, and destroy much of the corn. The door should also be formed with lathing so far as this may be done. As the object is to make the house as airy as possible, the bottom of the cribs and also of the passage, should be floored with lath: these should be stronger. The lathing on the sides of the cribs next to the passage should also be narrow, and the space between the laths, as wide as it may be left, without letting the ears pass through it, extending the height of them from the floor up to the plate of the house. The pitch of the roof will give room to put the corn in from the passage, and also allow sufficient scope for air between it and the corn. The length of the building can only be determined by the quantity of corn which is to be stored in it. If that be considerable, a door at each end of the building will save labour in putting in and taking out the ears. The roof should have the same pitch down the plate at the ends as it has at the sides.

To exclude driving rains and snows,* as well as it may be conveniently done, the eaves of the roof should extend about four feet from the body of the house, at the ends as well as at the sides of it. The pitch of this projection or offset in the roof, ought to be inconsiderable; for the more it droops, the more will the air be excluded. It should be supported by short braces running out from the sides

* The driving in of rain and snow in dry climates, seldom proves injurious. In wet climates, however, it is otherwise. It really seems more difficult to save corn in them, than it is to make it; especially if gourdseed forms part of the variety; but even the hardest varieties carry much moisture into the crib.

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and ends of the building; the roof may be thatched, provided it be well done.

To prevent the bad effects of moisture from the ground, set the building on posts at least four feet above the level of the earth.* To exclude mice and rats, cap each post all round, just underneath the bottom of the crib, with boards ten inches wide, and smoothly planed, fitting the ends of the four corners of the cap, where they meet, very closely together, and drooping the outer edges of the caps three inches lower than where they are nailed fast to the post. Neither rats nor mice were ever seen in my corn crib capped in this way. Some care, however, is necessary to prevent carelessness from furnishing the means by which these intruders may climb up into the crib. The posts should be cut off square at their lower ends, and set on stones, in the same way as recommended for barrack posts to stand. Here it may be proper to observe, that the stones on which my corn crib was set, were neither wide nor thick. The consequence was, that the rats burrowed under them while the crib was full of corn, and gradually settled to one side, until it fell, with eighteen or nineteen hundred bushels of corn in the ear, in it. The crib, in falling, was so shattered to pieces as to be rendered useless. This seems to determine that the stones used for this purpose, should be large, and sunk to a considerable depth in the ground. If the posts be sunk into the ground, they rot much sooner than the rest of the building

Very little need be said of the shovel plough, except that the shovel should be formed for no purpose so lean at the point as it is used by some farmers. A full point cuts up the ground much more effectually, and does far better and more expeditious work, between and among the superficial roots of trees.

For the shallow cultivation of plants which has been recommended by me, the point should be formed still fuller, more like the half of a circle, than it is made for any other purpose; for unless the point be made wider, in proportion to the upper part of the shovel, it will, without great care and trouble, dip by far too deep.

The beam and handles necessary for the skim are very similar to those for a light swing plough. The hoe or share is triangular, somewhat like that recommended for the hoe harrow, and the coulter also sharp in front and point.

In forming the share for the skim, or the hoes for the hoe harrow, wings of sufficient width and strength are best. These should commence at the point where the coulter is fixed, and extend far enough back. This will leave a considerable opening between the wings; especially at the hinder part of them. When formed in this way, they may be set so as to perform the work better than if the shares or hoes were solid; some weight of iron will also be saved.

The share or hoe for the skim may also be eighteen inches long, and twelve inches wide behind. Or it may be increased in width

* These posts should form a part of the building by running up to the upper plate of it; into which they ought to be mortised.

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and length, to suit the intervals between the plants: provided the size of it be not extended too far.

A rake with strong tines attached to the hinder part of the implement, in the way that has been described for fixing a rake to the drill, will answer the purpose of a tined harrow following it.

A rake of the same description attached to the hinder part of the small hoe harrow will save the labour of its being followed by the tined harrow when corn or other crops are cultivated by it, unless the ground be very needy.

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CHAPTER XXXVIII.

On hedges.

Of the necessity of hedges in our older settlements much has been judiciously said. Many plants that are calculated to form them have been pointed out. I shall therefore say but little on this subject.

Where soiling is practised the expense of inside fencing to protect the hedge from cattle, &c. may be saved. Where the line divides the fields of an adjoining neighbour who does not soil his cattle, if he will admit the dead division fence to stand on his grounds the expense of a protecting fence will be saved.

Banking and ditching are very injurious as well as very expensive. A very considerable space is occupied by them which might be much better employed. The construction of them is exactly calculated to retard the growth of the plants, and to render the cultivation of them tedious and expensive. There are a multitude of plants that will make an impenetrable fence without the aid of bank or ditch. If a manured fallow crop of sufficient width be grown along the line of the hedge before it is planted, the weeds and grasses will be greatly crippled, and many of them destroyed: the grounds will be enriched to excite the speedy growth of the hedge. This may be constantly kept free from grass and weeds by the hoe and tined harrow, and hand hoers following them, until the hedge is fully formed; after which, the shade and the fall of the foliage will keep the grass and weeds under in the line with it.

It seems to be throwing money away to plant a hedge in a poor soil, and leave it to be overrun and choked with grasses and weeds. We have, however, too many sad specimens of this mode of management: yet it is to be feared too many of these instances will appear hereafter; for a hedge requires great attention until it is completely established. If, after this be done, proper care be not regularly given to pruning, &c. it soon becomes an unseemly mass of useless vegetation.

Evergreen hedges have a beautiful appearance in the winter: when a deathlike and dreary sleep has put an apparent stop to vegetation, and destroyed almost every green thing, the sight of an evergreen cheers the mind. Nature seems to have formed them to be emblems of eternal youth. When covered with sleet or snow, the rays of the sun exhibit a silvered surface throughout the whole length of the hedge richly inlaid with an enchanting green. It is true, this lovely appearance is transitory, but so are most of the enjoyments of man. The green, however, still remains to sooth

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the eye. It is said that the red cedar forms an excellent hedge. The same is also said of the spruce pine. The numerous and small limbs of this tree seem well calculated to be trained and wattled in between the bodies of the plant so as to form a fence which no domesticated animal can either penetrate or jump over. Some say that good fences are formed with the white pine. No question but it or any of the pines grown in this country will form an excellent fence. The holly, though slow in its growth, forms a beautiful compact hedge.

It would, however, seem, if we may believe all that is said in the third volume of the Memoirs of the Philadelphia Agricultural Society of the pyracantha, an evergreen thorn, as a very valuable plant for forming hedges, that it should be used for this purpose in preference to any other evergreen known to us. The writer, after describing its useful properties, says, "I have said nothing of the beauty of pyracantha hedges, that being only a secondary consideration; nevertheless, few of the vegetable tribes can exhibit in the fall a more splendid display of beauty than the vast profusion of its clustered berries among the empurpled foliage of the plant, particularly as it appears before the eye that pursues the long continued perspective riband of it in a hedge-row."

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CHAPTER XXXIX.

On cats.

This animal, when properly managed is very useful to the farmer. His houses, barns, &c. are often infested with rats and mice. His trees, grasses and crops of various kinds are frequently injured by ground mice, squirrels and other small quadrupeds. Nature seems to have formed the domesticated cat for the express purpose of subduing and destroying those intruders, so far as it may be done.

It, however, appears, that as the support of many of the larger and more powerful animals, depends on the existence of those which are continually pursued and destroyed by them, nature has wisely limited their power, vigilance and sagacity, so that a sufficient remnant of the weaker animals always escapes, to propagate and keep up the various races to which they belong.

It therefore seems useless to attempt the entire destruction of many of the different races of animals, as they are necessary to the well being and support of the whole. It would appear, however, that population, while it favours the general destruction of some kinds of wild animals, is very favourable to the extensive propagation of other classes of them.

Thus, some birds and quadrupeds are only to be seen where population exists, and increase with it; while others which are plentiful in our forests, and other lonely wilds, dwindle as population extends, and decrease until they seem to be entirely destroyed; except in some few places which happen to be well calculated to hide and secure them from the ingenuity of man.

This settlement was formed in the interior of an extensive and lonely forest. It was more than twenty miles to the nearest inhabitant. For several years no rat was seen in it. It is said that the first seen here, came in a waggon load of goods. Be this, however, as it may, they are now as plentiful as I have ever seen them any where. Some few partridges and crows have also found their way here.

When I first moved into the houses where I have lived since I came to this place, we were not troubled with rats. The former occupant had kept cats. It was not very long, however, before they became very numerous, and did much injury. They were so very plenty that my boys killed fifty-six in the course of two days, by searching out their dens and hiding places.

Before I proceed further, it may be proper to remark, that the common house cat, brought up in the back-woods, is early taught to depend on its own energy for its support. It is, of consequence, not enervated by sloth, on the contrary, it is very vigilant, always

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engaged in pursuing, or patiently watching its prey. The cause of this is readily explained: the settlers of new countries are in general very poor. They have but too often little provisions for themselves; therefore, the animals kept by them, are early taught to shift for themselves in all cases where it can be done.

I procured a cat of this description from a neighbour living about three miles from my house. The animal was fastened up two or three days in my garret, to accustom it to the house. After this, it was suffered to run at large through it. In a short time we were not troubled with rats. Some person, however, killed my cat, and the house became as much infested with rats as it had ever been. Another cat was procured, and the rats were either banished or destroyed: in a short time as this cat was also killed, the house was again infested by rats and much injury done by them; another cat was procured and the result has been the same. We are not injured by rats.

The first crop of wheat grown by me here, was extensively injured by rats. They were so plentiful that it was common to see three or four of them come up in the day, through the holes which had been made by them in the cabin floors, and scout about while the people were sitting in the room.

Two cats were procured and sent to the farm, with strict orders to give them nothing to eat, and to keep every kind of provision out of their way. They so far destroyed the rats that we did not observe they had done any injury to the crops of the ensuing year, although stored in the same barn.

One of my neighbours, who had taken a dislike to cats, shot all that appeared on his premises, and nearly one-third of his wheat crop was destroyed by rats.

When my people removed to another farm, the cats were so wild that they could not be caught: consequently were left behind. My cats, however soon abandoned the premises, and found their way through the woods, to the house of a neighbouring farmer. Many facts have clearly determined that, be the cats wild or tame, they will not stay on any farm where no human being is living.

No rats appeared at first, on the farm to which my people had removed. It was not long, however, before they became plentiful, but a single cat being introduced, serious injury from them, did not occur.

The cat should be kept wild, and never suffered to enter the farmer's house or kitchen until after the family has gone to rest. After this, however, they should have full scope, wherever they may be useful. When game becomes scarce, as it does sometimes in winter, sufficient food should be left where they can readily get at it.

When the rats and mice fail, in and near the farmer's dwelling, the cats will traverse every part of the farm, in quest of moles, ground mice, squirrels, rabbits, &c. These smaller quadrupeds, with many birds, are the ready victims of its active prowess, or pa-

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tient vigilance, unless the carelesness or ill judged benevolence of the family, weaken or destroy the native energies of this invaluable animal, by supplying it with food, when this can be readily obtained, by its own talents and industry.

The cat, when properly ordered, is the surest and best defence the farmer can make, to save his trees and crops from the depredations committed on them by the smaller quadrupeds.

The cat neither burrows, nor gnaws into mischief. Nothing can be easier than to prevent injury from it. It neither injures nor destroys the farmer's crops before nor after they are gathered. Nature has exactly calculated it, and the dog, to be extensively useful to man. The proper management of the dog, seems to be generally so well understood, that it would be useless to say any thing of it.

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CHAPTER XL.

On orchards. It is believed a better form than that in general use may be given to fruit trees.

It would be a tedious task to copy the great mass of valuable information which has been published on the management of orchards; I will therefore confine myself to such remarks on this subject, as seem best calculated to induce farmers to put into active practice what they already know, together with some observation on what is believed by me to be the best form for fruit trees.

The proper form, however, of a tree, be that what it may, ought to be given to it while it is young. Lopping off large branches inflicts wounds, which often introduce decay, and the premature death of the tree. By cutting off the suckers and supernumerary branches while they are very small, the sun and air are more freely admitted, and the tree is not exhausted by the useless and injurious application of the nutriment consumed by them.

The suckers and supernumerary branches ought to be removed, as soon after they appear as can be readily done. Grass and trees are immediately opposed to each other. Where the one thrives, the other invariably declines. They wage perpetual war, until one or the other is entirely rooted out; this may be clearly seen in our uncultivated wilds where nature solely presides; it has also been made manifest to the attentive observer by actual practice.

Where the system of perpetual ploughing and cropping prevails, the fruit trees live much longer, and thrive better, notwithstanding this mode of management greatly exhausts the soil.

Where more attention has been given to grass, it has been the too general practice to keep orchards long in it. This seems to have originated from observing, that the trees and their roots greatly increase the labour and expense of cultivation, and that the shade considerably reduced the product of the crops.

Red clover is frequently sown in orchards, and perhaps with a view to keep the soil open and mellow, for the more ready admission of the roots of the trees; it, however, commonly happens, that the grounds are not ploughed for a considerable time after the clover seed is sown, of consequence this plant is rooted out by the hardy native speargrasses; these form a close matted consolidated sod, which is in itself very injurious to the tree, as are also many of the numerous insects which find shelter, and a part of their support in and upon it.

Hence it is, that in settlements where attention is given to grass, orchards generally decline, become unproductive, and premature decay commonly ensues.

To render orchards productive, and to prevent the premature

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death of the trees, they should be kept in constant cultivation. If the grasses, however, be not frequently grown between the cultivated crops, this mode of management will require much farm yard manure, to keep up the fertility of the soil.

Maize will be a very proper fallow crop while the trees are young, but this plant suffers exceedingly by shade after the trees are larger. Potatoes suffer less from shade than any plant known to me, that is employed for a fallow crop. It is said that buckwheat injures the trees less than any other crop which is sown broad cast;* but it would seem, that any of the small grains that prospers best under the shade, might follow the fallow crop, without doing any material injury to the trees.

It has been asserted that red clover injures orchards, this has however been controverted; no question but orchards may have been greatly injured when red clover was the only grass sown in them, and the grounds were not ploughed until the native speargrasses had rooted it, or the greater part of it, out, and formed a matted consolidated sod. It is well known, however, that the roots of clover do not bind the soil: also, that insects will not be generated in great numbers, if the stubble crop of that grass be suffered to rot on the ground, and the first crop of the ensuing year be mowed, and the second crop turned under for manure. This will be long enough for the grasses to be continued, provided they be frequently sown and managed as above directed. The grasses will harbour ground mice, and they often injure trees sadly. The orchard, however, will be but little if any injured by these intruders, if the cultivator keep a sufficient number of cats, and order them properly.

Orchard grass grows well under the shade of trees, as neither it, nor any of the speargrasses known to me, form a matted consolidated sod the first year they are mowed, it may be sown, provided it suits the farmer's purpose better than clover, or the grounds become tired of a frequent repetition of the latter grass.

Orchards might be rendered very valuable to the plain practical farmer, were it not that he generally plants by far more trees than can be judiciously managed, without greatly interfering with his other concerns.

One tree managed as it ought to be, will be found much more profitable than five ordered as they most usually are. The proper management of them, however, costs no small share of tedious and laborious attention: by far too many do not seem to be aware of this; they act as if they thought procuring, and planting them, formed the principal part of the business, and seem to think that while they are engaged in the work, they may as well plant many as few. To save labour, and avoid tedious attention, the roots are commonly cut off too short, and sadly mangled in removing them

* This may be sown broad cast in the orchard to prepare the ground for small grain to follow after it, provided the soil be prepared in the way that has been pointed out in my book on Cultivation.

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from the nursery; after this they are often bundled up in a hurry, and be the journey long or short, put into a waggon or cart, with but little if any care taken to defend their tops or roots from being rubbed or chafed by the way; or to prevent their roots from being sadly injured by frost, drying winds, or the heat of the sun, as the case may happen to be. To save the labour of staking, and otherwise securing the tree from the injurious action of the wind on its top, it is planted deep into the poor inert earth, and the hole in which it is planted is frequently made so narrow, that the scanty portion of roots remaining attached to the plant is to be forced into it; after this it too seldom happens that the orchard is defended by a proper fence, of consequence the trees are often sadly injured by cattle, sheep, &c. I have sometimes seen the orchard planted where the owner must have known, all the cattle in the neighbourhood would have free access to it, and once after the trees had been bought at a high price, and carried at a great expense more than two hundred miles. It would seem, however, that farmers must and will have orchards; also that too few of them duly consider, that it requires no small share of labour to plant and defend them properly, and that this portion of the business is trivial, when compared with the tedious and laborious attention necessary to keep them in good condition, and to preserve them from the injuries to which they are exposed. Insects prey upon the foliage, roots, trunk and branches of trees; some of these intruders, if care be not taken, bore deep into the wood and destroy the tree; others perforate and corrode the bark so much, that it cannot live, and some insinuate themselves between the bark and sapwood of the tree, and feed upon the more tender substances found there, until they have destroyed it.

As these animalcula increase rapidly, unless proper care be taken to destroy them, the infected tree becomes weak and diseased, of consequence incapable of being productive, during the time it may happen to live.

Of this order of nature we have, however, no just cause to complain. The reason of man has given him sufficient dominion over inferior animals to prevent them from doing any very material injury to him. More he should not have, as from the inconsiderate and inveterate complaints against animalcula and weeds, it is evident he would destroy the whole, if he possessed the power to do it: notwithstanding it is equally evident, that in doing this he would eventually destroy himself, as has been before explained, unless war, rapine and depopulation of countries should cease,* and a good system of husbandry generally prevail.

Moist climates, shaded situation, and too close planting, favour the growth of the mosses. The suckers and useless branches prove very injurious unless they are speedily removed.

Thus we see the labour and minute attention necessary to pre-

* In those cases nature has to repair the damage. Without the aid of weeds and animalcula but little could be done by her.

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vent or remove any very serious evil from the various injurious causes which have been enumerated, are very considerable. With proper attention, however, it may be generally done, by some or other of the various means which have been recommended, and found by the actual practice of judicious and respectable cultivators to succeed. It is only reasonable to believe that what has succeeded in the practice of one, would do the same in that of any other, if equal care, and judicious attention were employed.

Observation, however, seems to determine, that too many trees to be well managed, together with the inattentive and injudicious application of the remedies which have been found effectual in the practice of those who properly employed them, have caused them to fail.

It is certain that I never could get even the worms properly and effectually removed from the roots of my peach trees, unless I stood by and saw it done, nor indeed even then, without encountering nearly as much trouble and fatigue as if it had been done by myself, and vastly more vexation and perplexity. The same also uniformly happened, in the execution of all the other means employed by me, to preserve this invaluable tree; therefore, knowing well what has happened in my own practice, I am not bound to place the same confidence in the assertions of those gentlemen, who say, they have tried all the remedies that have been proposed to save the peach tree, and that the whole have been ineffectual, as I should have been, if they had at the same time informed us, that they had carefully executed the business themselves, more especially as gentlemen farmers seldom encounter the labour necessary to execute experiments of this description; they too generally depend on their workmen, and it commonly requires far less labour to slight a job than to do it effectually.

It is said by some gentlemen our climate, or an alteration in it, is hostile to this tree. I am now in the sixty-fifth year of my age, and have seen none of the alterations of which these gentlemen speak.

The climate of Pennsylvania does not seem so favourable to the peach tree as some others; especially for the more tender varieties. It is, however, rarely if ever killed by the vicissitudes of the seasons, unless it has been previously debilitated by the worm in the root, or otherwise injured by insects.

To prove this, I would simply ask, if the tree is injured so extensively by the hostility of the climate, how does it happen that it commonly continues healthy until age has given time for insects to propagate and prey upon it, in sufficient numbers and extent, to cause debility? It certainly cannot be naturally stronger and better calculated to withstand inclement seasons when it is very young, than it is in the more advanced stages of its growth. Yet we commonly see that it thrives while it is quite young, although it generally becomes debilitated and dies before it has attained its full size.

Having observed and reflected on the form which nature gives to

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a tree, where the plants have not happened to stand sufficiently close together to be trimmed by shade, I am disposed to believe, that in giving fruit trees the form which seems to have been generally considered best, art has taken by far too much out of the hands of nature: therefore propose the trial of a different plan.

As this, however, rests merely upon an opinion that has not been put into practice by me, or to my knowledge by any other person, and I do not wish to mislead, I would advise those, if any there should be, who may happen to think favourably of the plan, to try it on a contracted scale, as there may be reasons, which may have escaped my observation, and which, indeed, nothing short of practice can unfold, why the plan may be a bad one, notwithstanding I believe there are many substantial reasons to suppose it vastly better than any method that has yet been proposed, and would certainly put it into practice, if trees to which the proper form had been given to them in the nursery were to be had.

Where trees happen to grow so wide apart that nature cannot trim them by shade, the limbs branch out regularly from near the ground to the top of the tree. The undermost branches are the longest, and those above them regularly become shorter in due proportion as they grow higher up, until a small narrow top is formed. This gives to the tree a form somewhat like a sugarloaf.

The advantages supposed to be derived from this form are: first, the limbs will be much more numerous, as they grow and spread themselves out from near the surface of the soil to the top of the tree. They will be also much slimmer and shorter than limbs which have been compelled by art to form much higher up. If nature be opposed at any one point she becomes deformed by the unnatural growth of some other part. Thus compressing the foot in China causes the ankles to become unnaturally large. When a small waist was fashionable in Europe, the size of the hips and shoulders was increased. It is believed that the smaller and more numerous limbs, will be far better calculated to produce fruit bearing branches and to support the weight of the fruit grown on them, and that it will be more regularly spread on them than on the much larger limbs. The useless wood and length of the latter act as a powerful lever, and often cause them to break or split off, when loaded with fruit.

Secondly, the gradual taper in the form of the tree from the bottom to the top of it, seems far better calculated to let in the sun and air to mature the fruit, than the usual form.

Thirdly, the gradual declension in the size of the body as well as of the length and size of the branches or limbs of the tree, from near the ground to the top it, together with the wider spreading parts of it being near the earth, greatly lessen the power of the action of the winds on it; consequently it will be far less subject to be blown down, than a tree forming very heavy and wide spreading branches, at the usual distance from the ground.

Fourthly, it would seem that the soil in orchards managed in this way will require no cultivation; that the fall of foliage growing on

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branches which commence their spread so near to the ground, together with the covering formed by the leaves falling from them, will prevent the growth of the grasses; also, that the fermentation and decomposition of the fallen vegetation annually gathered in this way, will furnish a sufficiency of manure, and keep the grounds open and mellow for the growth of the roots of the trees,* particularly as the same interesting processes of nature, seem to have taken place in the practice of Mr. Thomas Coulter, of Bedford county, Pennsylvania.

To illustrate my subject, however, and also to prove that the life, health and vigour of the peach tree may be long preserved, I will quote the essential parts of this gentleman's observations on the management of his peach orchard. He says:

"The principal causes of the peach trees dying whilst young, are the planting, transplanting and pruning the same stock; which causes the stock to be open and tender, and the bark of the tree very rough: this roughness of the bark gives opportunities to insects to lodge and breed in it, and birds search after these insects for their support, and with their sharp bills, wound the stock in many places, from which wound the sap of the tree is drawn out, which congeals, and never fails to kill, or render the tree useless in a few years. To prevent which, transplant your peach trees, as young as possible, where you mean them to stand; if in the kernel, so much the better; because, in that case, there will be no check of growth which always injures peach trees. Plant peach trees sixteen feet apart, both ways, except you would wish to take your waggon through the orchard to carry the peaches away; in that case give twenty-four feet distance in every fifth row, one way. After transplanting, you may plough and harrow amongst your peach trees, paying no regard to wounding and tearing them, so that you do not take them up by the roots. In the month of March or April, in the third year after transplanting, cut them all off by the ground; plough and harrow among them as before, taking care not to wound and tear them in the smallest degree, letting all sprouts or scions grow that will grow; cut none away, supposing six or more should come from the old stump; the young scions will grow to bearing trees on account of the roots being strong. Let no kind of beasts into the peach orchard, hogs excepted, for fear of wounding the trees, as the least wound will greatly injure the tree, by draining away that substance which is the life thereof; although the tree may live many years, the produce of it is not so great, neither is the fruit so good. After the old stock is cut away, the third year after transplanting, the sprouts or scions will grow up all round the old stump, from four to six in number: no more will come to maturity, than the old stump can support and nourish, the remainder will die before they

* As this manure will be regular and less powerful than dung, it is thought the fruit will be less liable to fall prematurely, than sometimes happens when farm yard manure has been liberally employed, for the cultivated crops grown in the orchard.

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bear fruit. These may be cut away, taking care not to wound any part of any stock or the bark. The sprouts grow all round the old stump; when loaded with fruit, will bend and rest on the ground in every direction without injuring of them for many years, all of them being rooted in the ground, as though they had been planted. The stocks will remain tough and the bark smooth for twenty years and upwards; if any of the sprouts or trees from the old stumps should happen to split off or die, cut them away, they will be supplied from the ground, by young trees, so that you will have trees from the same stump for one hundred years, as I believe I now have trees thirty-six, twenty, ten, five and down to one year old, all from the same stump. The young trees coming up after any of the old trees split off or die and are cut away, will bear fruit the second year; but this fruit will not ripen so early as the fruit from the old trees from the same stem. Three years after the trees are cut off by the ground they will be sufficiently large and bushy, to shade the ground so as to prevent grass of any kind from matting or bedding the surface, so as to injure the trees: therefore ploughing is useless, as well as injurious; useless, because nothing can be raised in the orchard by reason the trees will shade all the ground or nearly so; injurious, because either the roots, stock or branches will be wounded, neither is it necessary ever to manure peach trees, as manured trees will always produce less and worse fruit, than trees that are not manured; although by manuring your peach trees they will grow larger, and look greener and thicker in the boughs and cause a thicker shade, yet on them will grow but very little fruit, and that little will be of a very bad kind, generally looking as green as the leaves, even when ripe, and later than those which never have been manured.

"Peach trees never require a rich soil; the poorer the soil the better the fruit; a middling soil produces a more bountiful crop.

"The highest grounds and north sides of hills are best for the peach trees: they keep back vegetation, by which means the fruit is often preserved from being killed by late frosts in the month of April in Pennsylvania latitude, I have made these observations from actual experience.

"A gentleman from Monongahela county in Virginia, called at my house and asked me who instructed me to cultivate peach trees: I told him that observation and experience were my teachers. The gentleman observed, that Colonel Luther Martin, in the lower parts of Maryland, and another gentleman near the same place, whose name he could not recollect, were pursuing the same plan advantageously."*

Here again we see that plain practical farmers are not (what too many gentlemen seem to suppose them to be,) "the most ignorant people in the world."

These gentlemen, however, should have reflected that nature is

* See Domes. Encyc. vol. iv. pages 244 to 246.

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not partial in the distribution of talents; that the occupation of these men naturally leads to philosophical inquiry; that those among them who possess strong and inquiring minds are naturally led to investigate cause and effect as much, if not more, than any other "set of men in the world," at least so far as the economy of vegetation is obviously connected with practical husbandry; also, that even those of them who do not know a letter in the alphabet, but at the same time possess talents and attention equal to the task, are by the mere dint of practical observation, capable of making very useful and important discoveries in the economy of nature and practice of husbandry: such as would do honour to any gentleman, be his education and talents what they may.

Mr. Coulter's discovery of the means by which the peach tree may be long preserved, and his judicious remarks on that subject, are highly interesting. I do not know this gentleman, but believe he has candidly stated facts as they seemed to occur in his practice, for I have observed that when the stem of the peach tree had been sadly injured by the horns or mouths of cattle while the plant was young, that in place of forming a new body composed of a large solid stem, the body is divided into a number of small stems or branches growing out in different directions from around the old stump or stem; that the bark on these small branches is vastly smoother and more compact than that on the trunk and larger parts of the limbs of a tree to which the usual form has been given.

The cause of this is evident: as the size of the body or limbs of a tree increases, the bark uniformly becomes more rough and open: the exterior parts of it separate at and near the surface, and also in part, from the the interior bark underneath it. In doing this, they are divided into numerous pieces of various shapes and forms. These loosened and dead looking pieces of bark,* when acted upon by sufficient moisture and heat, furnish decomposed vegetable matters, that greatly favour the growth of the mosses, especially in moist climates and shaded situations; and it may be, that when the bark is not injured by the mosses, &c. this decomposed vegetable matter is also slowly applied to the nourishment of the tree by the mouths of the vessels formed in the living bark.

Be this, however, as it may, it is evident that the openings between, and the hollows under, the rough, dead looking pieces of bark, furnish very convenient and commodious habitations for innumerable animalcula, which prey upon the wood, bark and foliage of the tree. It seems probable, however, that "planting, transplanting and pruning the stock of the peach tree," may, by promoting the debility of it, "cause the stock to become" more "open and tender, and the bark of the tree rougher," than it would be if it was not removed from the place in which the seed was first

* They are, however, alive where they closely adhere to the solid bark underneath them.

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planted: still, nothing can be more evident, than that whether the tree be or be not removed or pruned, the bark on the body and larger parts of the limbs will be rough, open and loose when the usual form has been given to it.

The readiest and most effectual way known to me, to remove the roughness in the bark, is to whitewash with lime the trunk and every part of the branches of the tree on which either moss or rough, loose bark appears. This causes the moss and rough bark to peal or fall off, and gives to the remaining bark a smooth, firm, and very healthy looking skin. The very extensive harbour for insects is also removed, and multitudes of them and their eggs, &c. destroyed. Care, however, should be taken to extend the whitewashing to the small, as well as to the large, branches of the tree.

Lime, so far as my observation extends, invariably promotes vegetation wherever it has a sufficiency of animal and vegetable matters to act upon, unless the quantity of lime be either too great or too inconsiderable. From this, together with the unusually healthy and vigorous look of trees which had been whitewashed, it would seem, that the lime not only acts by stripping off the mosses, and loose, rough bark, but also by converting a part of it, and of the animalcula sheltered by it, into such nutritious matter as the absorbent vessels in the bark are capable of imbibing and applying to the nourishment of the tree. If this, however, does not happen, these substances certainly furnish nutriment after they fall to the ground.

That those vessels are capable of performing to a certain extent the same functions as the leaves, seems to be manifest. I have seen inconsiderate practitioners cut off every limb from an apple tree after the body of it had attained three or more inches in diameter; leaving only stubs of a few inches long, in which they fixed grafts. The grafts did not succeed, owing, as I believe, to the system of the tree being generally debilitated in consequence of its having no branches on which leaves could be formed in proper time. The tree, however, put out new branches the ensuing summer, and formed a new top. This, I suppose, would not have happened, and that the tree would have died, if the bark had not to a certain extent performed the same functions as do the leaves.

Whether it would be either safe or proper to apply the whitewashing with lime annually, is unknown to me. I have only seen it used occasionally. Scrubbing the trees annually with soapsuds will destroy moss and insects, and keep the bark smooth and healthy. It has been said by some gentlemen that if this be done with water alone similar effects are produced.*

Be this, however, as it may, the cultivator should use such means as will effect these important purposes. The application of the

* If this be done when the vegetable matter is well saturated by rain the labour is greatly lessened, if either soapsuds or pure water be used.

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whitewash is by far the least laborious practice known to me. So far as I have seen it tried the beneficial effects produced by it seemed to be astonishingly great: still, a frequent and long continued use of it, or any other substance equally corrosive, may prove injurious. The corrosive property of the lime may, however, be greatly lessened by slaking, and letting it lie long exposed to the air after it has been slaked. It would seem, that if the trees be annually whitewashed, it will be, at least, best (after the first application of it) to reduce the caustic property of the lime more or less, as practice and observation may determine.*

Mr. Coulter observes, that "manured tress will always produce less, and worse fruit, than those trees that are not manured." This may be the case if the grounds be too highly manured. It is certainly so when the soil is too rich for wheat and other plants better known to us than the peach tree.

It is, however, evident that his peach orchard was annually manured, as are our forests, by the fallen vegetation and animalcula which subsisted on it, and on the living parts of the tree. The number on the latter was very much diminished in consequence of the smooth form and healthy texture of the bark. Yet smooth as this bark may have appeared to the eye, it afforded abundant and commodious shelter for myriads of animalcula, so small as to elude our sight. Nay, more, it is probable that innumerable tribes of them, have been formed so small as not to be discovered by the most highly improved microscopes that have yet been, or ever will be invented. Every leaf in his orchard teemed with living animal beings, descending in due gradation from those large enough to be seen by us, down to others so extremely small, that even our imagination cannot trace their minute, but perfect form.

The freer and more powerful action of the wind on the fallen vegetation, will naturally blow off more of it from the orchard, than is blown off from the interior parts of an extensive forest. If the limbs of the trees, however, are caused to grow very near to the ground, the fallen vegetation is very considerably defended by them. Therefore, nothing like as much of it is blown off from the soil as from an orchard ordered in the usual way. If the orchard be defended by a good fence, far less of this light vegetation will be blown off.

Although paying no regard to wounding and tearing the trees, if they be not taken up by the roots, when ploughing and harrowing

* I have never used fresh slaked lime for this purpose, therefore do not know but it might be injurious even in the beginning. I do not, however, believe it would: on the contrary, it might be much more extensively useful. Last year I whitewashed with lime (that came to hand soaking wet, but had after this lain about two years well sheltered from the weather) some apple trees overrun with moss. The moss has been extensively destroyed, and much of the loose bark has peeled off. A great deal of both, however, still remains on the trees. It would therefore seem, that the whitewash was not sufficiently corrosive.

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among them previously to cutting them off by the ground, may not very materially injure the ultimate prosperity of the orchard, it is evident that the plants thus mangled and torn, will be more or less debilitated; therefore, less vigorous and fruitful, at least for some considerable time, than those which have not been thus used.

The principal objections to forming orchards of any kind, by cutting off the trees by the ground, while they are young, seem to be: First, by planting the seed, the same variety is seldom obtained. It may be better, but it is far more likely to be worse, if the seed be from good fruit. Secondly, if improved varieties are ingrafted into stocks grown for this purpose, as low down as it can be done, quite as many, or perhaps more of the stems grown after the trees are cut off by the ground, may proceed from the unimproved roots. Thirdly, although the practice, so far as the peach tree be concerned, seems to be highly important, as it appears to be well calculated to preserve the health and vigour of it for many years, it does not seem reasonable to believe that altering the natural economy of trees so extensively, can be in common cases adviseable; especially as we generally find that any material alteration in the natural economy of plants very commonly does manifest injury to them.

The form suggested by me is that which nature gives to trees, when they do not stand close enough together to be trimmed by shade. It is, therefore, presumed, that the organization of the plant will be far better calculated to perform the functions she has assigned to it, than can happen when the usual form is given to it by art, or when the natural form is still much more altered by cutting off the tree close by the ground, when it is young.

The growth of useless and very injurious suckers, &c. seems to clearly to determine, it was intended that man should assist nature by removing exuberant redundances from fruit trees. It also appears that he may powerfully assist her by speedily removing the branches which are opposed to the proper form of timber trees. She can only do it by the tedious process of shade. This causes the tree to grow very slowly until after it has been trimmed, as has been before explained.

Practice and observation, however, as clearly determine, that except it be to admit a lesser evil to prevent a greater, plants should not be mutilated, or their roots and tops compelled to take unnatural forms or postures. It is, no question, both useful and ingenious to grow, or to rear them for a limited time, under frames, and to fasten them to, and spread them out against walls, in climates opposed either less or more to the economy of them: still, reason, observation, and practice dictate that the same unnatural measures should not be pursued in the management of these plants, when they are cultivated in climates favourable to the growth of them.

It is believed that the vegetation falling from the trees growing in their native form, will be so well secured by the limbs formed near to the ground, that neither cultivation nor the application of manure will be necessary.

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More labour, however, will be required in the beginning. The limbs will not grow any thing like so rapidly as from stumps which had formed extensive roots before the tree was cut off by the ground. Therefore, weeds and grass must be destroyed. To effect this, the hoe ought to be used underneath the branches, until the shade of the limbs and foliage, together with the fallen vegetation, become sufficiently extensive to perform this important purpose. The D hoe will eradicate these with by far the greatest expedition, and least injury to the branches of the trees. Where the limbs do not yet extend, the hoe harrow, with the tined harrow following it, will extirpate the grasses and weeds effectually, and with but little labour, until the shade and fallen vegetation render cultivation useless.

The increased number of limbs will cause them to be small: the bark therefore will be much smoother and more compact, than that grown on the limbs of a tree to which the usual form has been given. The tapering given to the body of a tree growing in the form which has been suggested, will also cause the bark, except that near the root, to be smoother, and more compact than that growing on the body of a tree formed in the usual way; it will, however, be much more rough and open, than that on the numerous branches which form the divided body of a tree, grown from a stump, after the original stem has been cut off by the ground, while the plant was young. This is the only material advantage which the latter practice has over the one proposed; it is however important, so far as peach trees may be concerned; still it does not appear sufficient to discourage the attentive and industrious cultivator, as there are several ways by which the bark may be kept smooth, firm, and healthy. It should also be recollected, that by applying the remedies necessary to preserve the health and vigour of the bark, innumerable insects are destroyed; also that it is only reasonable to suppose that even the smallest of these, may in general live by committing injurious depredations on the tree.

It is probable that farmers in general will consider, that no form which could be suggested can be proper, if the ground be devoted to trees alone. They should, however, recollect, that if the orchard be kept in grass, the trees become sickly, and premature death ensues. If it be subjected to the plough, the labour is greatly augmented by the obstacles presented by the roots and bodies of the trees; also that the cultivated crops are greatly injured by shade, of consequence are rarely productive. That without great care the trees are sadly injured by ploughing and harrowing among them. That if orchards may be managed without cultivating the grounds, a great deal of labour which seems to answer but very little if any good purpose, except that of preserving the health and vigour of the trees, will be saved. It should also be remarked, that as the form suggested for the trees, is far better calculated to let in the sun and air, and the length of the branches will likewise be considerably shorter than when grown in the usual way, or than when grown by

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cutting off the stem of the tree while the plant is young, much less ground will suffice, if the trees be planted no wider apart than is necessary to admit sufficient sun and air; further apart than this they should not stand: therefore the different sizes commonly attained even by different varieties of trees bearing the same species of fruit should be well considered previously to planting, and the distances between each variety regulated in due proportion to size.

Room should be left between the rows at suitable distances for a waggon or cart to pass through, if the size of the orchard seems to require it. As, however, one tree kept in good condition will be more productive than several managed as trees generally are, in common the fruit may be removed by driving the waggon or cart round the outside of the orchard; when this can be conveniently done it will be best, as the thicker the fallen vegetation is spread over the soil, and the more shade there can be introduced, consistent with admitting a sufficiency of sun and air to perfect the fruit, the greater will be the profit derived from the system of management that has been suggested.

It should be observed, that if grass and weeds be suffered to grow up among the young trees, the limbs are effectually trimmed by the close shade of this vegetation, so far up, that the subsequent growth of the part of the stem which has been thus trimmed, forms a body without limbs growing on it, nearly as long as the bodies usually formed by art.

This is clearly seen in grounds here which were dammed up and inhabited by beavers, before the dams were cut more than twenty years ago by the settlers. It appears that scattering trees, low growing shrubs, and high growing grasses and weeds, were the vegetation which followed this partial draining of the land. That where the shrubs, grasses and weeds extensively prevailed, the trees growing among this vegetation have been trimmed, in the way which has been described.

The proper form of a tree to be grown in the way which has been suggested, must be first given to it in the nursery; consequently the plants should stand much wider apart in the rows than common, and grasses and weeds continually kept under.* On no consideration should the main stem of the top of the tree be cut shorter or otherwise mutilated. If this be done, the tapering in the form of it, will not be sufficient to admit the sun and air freely, unless the trees be planted too wide apart to favour the design.

That the bark will continue smooth and firm on the divided body, formed by the numerous and small limbs which grow from the stump, after a young peach tree has been cut off by the ground,

* This is more highly important than at first sight it may appear to be: so much so that if the weeds and grasses are not timely, and effectually destroyed in the nursery, and also in the orchard, while the plants are young, naked bodies in place of limbs branching out near to the ground, will be formed by every tree.

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cannot be doubted by those who have observed the effects produced when cattle or any other cause destroy all but the stump.

As this accident, however, does not happen to a number of trees standing close together, the leaves which fall under the single and exposed tree, are blown away by the wind; therefore do not shelter the tender bark near to, or in contact with the ground, consequently the fly deposites its eggs. The absence of the leaves thus blown away, together with the sun being more freely admitted, by placing the limb in that way which best suits the occasional or constant cultivation of the ground, causes the grasses to grow under the tree; these are seldom, if ever, removed further in than the cultivated crops seem to require, and the tree is greatly injured by them.

Mr. Joseph Cooper, says, "From many observations and experiments, I have found that the worm most destructive to peach trees, begins to change to a chrysalis about the first of July, and remains in this state two weeks, when they come out a wasp, and proceed to couple and lay eggs near the roots of the trees, or in wounds in other parts, but do little injury, except near the roots, as, if attended to, the issuing of the gum will show their seat, and they are easily picked out; but their principal object is the root, the bark being softer there than on the body, and the rapid growth of the trunk near to the root, at the time of the wasps depositing their eggs, causes a number of small rents in the bark, which give the worms an easy entrance."*

Dr. James Tilton, says, "The wasplike insect which bores the bark of the tree, delights especially in that region just below the surface of the earth."† From the observations of those gentlemen, as well as those made by many others whose opinions might be quoted, it would appear, that if a suitable defence against the attack of the wasplike insect, be provided near the surface of the soil, no injury except such as may be readily removed is to be dreaded. Also, that if the bark be sound, compact, and healthy, no injury can be done by it higher up on the tree. The fallen leaves annually gathered round the body of the tree grown in the way suggested by me, seem well calculated to form the necessary defence of the tender bark near the root, especially as it is very obvious, that the leaves which fall in any one year, sink but little into decay, until a covering is formed over them by the fall of the same kind of vegetation in the autumn of the ensuing year.‡ As it may, however, happen, that by high winds, or other causes, this covering will be in some instances too scanty, the cultivator should in such cases increase it by putting more leaves round the body of the tree.

If it should appear after injury is no longer to be expected from the wasp, that the quantity of the leaves thus applied by the cultiva-

* See Mem. Phil Agr. Soc. vol. i. pages 12, 13. † Idem, page 189.

‡ As the leaves forming the upper stratum have not sunk into decay, they dry much sooner after rain, than the upper part of a hill formed of earth: consequently the moisture confined by them does not soften the bark near the surface, as does that confined in the hill.

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tor, were sufficient to soften the bark above that point were in common it is naturally soft, the covering should be immediately reduced.

Notwithstanding some gentlemen form hills of earth round the bodies of their peach trees in the fall, and seem to think that binding straw round them, would form a useful defence against the changes in temperature, which take place during winter, it would appear that sheltering them in that way, is exactly calculated to weaken and debilitate their system. Nothing, however, can be more evident, than that the moisture confined by the earth or straw, greatly softens the texture of the bark. In consequence it is far more readily punctured by the wasp.*

That peach trees growing in thickets, hedge rows or fence corners where shrubs, brambles, &c. prevail, thrive better and live much longer than those which stand in the open grounds has been remarked by many. This has been, however, attributed by some gentlemen to "their being preserved from the effects of sudden transitions from heat to cold, and from cold to heat." The arguments, however, by which they attempt to support this theory, seem to be opposed to reason and observation. One of them is evidently erroneous, to wit: "That in thinly settled parts peach trees flourish." The general practice of perpetual ploughing and cropping in recent settlements, saves the peach and other fruit trees, from the injury arising from the growing them in grounds which are commonly kept in grass: therefore, as the peach tree has not, in general, this additional evil to contend with, it is better calculated to withstand the depredations committed by the worm on its roots.

The ravages committed by the worm in the root, is, however, equally as destructive in thinly formed settlements, as where population is extensive. So are the depredations committed by the Hessian fly, after, by means not well understood, it has introduced itself in sufficient numbers to do extensive mischief. On my removal to Philipsburg, in 1812, I found fields of wheat as much injured by this insect, as commonly happens in old settlements where it has long prevailed; notwithstanding an extensive forest of from ten to twelve miles in width, thickly set with the tallest and largest trees I had ever seen before, as well as smaller ones and shrubs growing underneath their shade, divides this very thinly settled neighbourhood, from where more extensive clearings have been made.

I also observed that the worm in the root of the peach tree was as destructive here, as in old and very thickly formed settlements: that the fruit on the plum trees, removed, when young, from the forest, and planted in the gardens, was quite as much in-

* Therefore, when straw is bound round the body of the tree to defend it from the wasp, it should be put on early in the spring and removed when danger from this insect has passed by. It would appear that this practice alone, if proper care was taken in execution, would long preserve the life and health of the peach tree, notwithstanding gentlemen, who but too frequently farm by proxy, say it will do no good.

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jured by the beetle, as I had ever seen happen in older settlements. Thus the life of the peach tree, seems to be quite as precarious in this very thinly settled neighbourhood, as in any other place where I have been.

It would appear, however, that local causes, not so well understood as they might have been, if farmers had not been led astray by visionary theories, in some situations, preserve this tree from the depredations committed by the fly. Hence it is, that the peach tree often attains a very large size, and continues perfectly healthy for many years, where the air is highly impregnated with salt, as is the case near the sea, or where the bays, rivers, creeks or inlets from it are very salt. Some insects live, and thrive abundantly, when enveloped by salt, as in salted meat, fish, &c. There are others on which salt, even in small quantities, seems to act as a deadly poison. The wasp which injures the peach tree, may be, and I believe is, one of these. Still, theories, quite as much opposed to philosophy as they are to common sense and observation, have been formed to prove that the changes in temperature, which they say destroy the peach tree in the vicinity of Philadelphia, do not operate nearer to the sea. These theorists, however, might have seen that the humidity and warmth of the southerly winds, coming from a great distance over the sea, would more rapidly thaw the grounds near to it, than after they had traversed over a considerable extent of hard frozen ground; that the north-westerly winds which commonly follow soon, or immediately after, the warm spells in winter, are as cold or perhaps colder near the sea, than they are in the neighbourhood of Philadelphia, and that the ground there which had been previously thawed by the warmth and humidity of the southerly winds, which had passed over the sea, would be suddenly bound up by hard frost, from the powerful action of the cold northerly winds.

But in fact, it would seem, that the peach tree is not so readily affected by changes in the temperature, as some gentlemen seem to imagine. On the contrary, that it is quite as capable of withstanding these changes as many of our native forest trees. The latter are very often much injured and sometimes killed by severe frost, and so is it. There has been no effectual care taken to introduce the best or earliest varieties of peaches here. The trees seem to have been raised by planting the stone, and but little, if any, attention given, whether the seed was from late or early, or from good or bad fruit.

This may have caused the fruit to ripen much later than it would otherwise do. The climate, however, seems to be considerably opposed to the early ripening of it, for the fruit in common is more or less injured by frost before it is ripe. In the year 1817, not a single peach ripened in this settlement. As nature does not loosen the grasp of the leaves so that they may fall while the fruit is yet quite green, the leaves on the peach trees thus circumstanced, hung on it, and retained their native green as long as did the leaves

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on the hardiest deciduous trees growing in our forests: of consequence, some considerable time after the leaves growing on the more tender varieties of forest trees, had been stripped of their native green by frost, and were falling off.

Now it would seem, that if the general system of the peach tree were so tender as some gentlemen have represented it to be, it would be so much affected by the changes in temperature, that it would not support the colour and vigour of the leaves so long.

It would be useless for me to describe the many ways by which respectable cultivators have informed us, the life, health and vigour of the peach tree have been long preserved. There seems to be no more reason to doubt the facts as related by them, than there is to doubt any other facts resting on respectable testimony; especially, as in general the means proposed appear to be calculated to effect the end. The reason why they have not generally succeeded, seems to be, that all of them require more attention and perseverance than the farmers in general are disposed to bestow on an object that is not particularly connected with their more important concerns.

Be this, however, as it may, if my theory be correct, (which the cultivator will, I trust, recollect, remains yet to be tried,) this tree may be preserved from the injury done by the fly, without labour or expense, by the leaves which fall from it,* provided the orchard be so ordered that the leaves falling round the stem, be confined either by the means which have been proposed, or in any other way by which it can be done without employing labour to effect that purpose. As the fallen leaves furnished by the branches of the peach tree while it is very young, may not be found sufficient to defend it from the injury done by the fly, I would advise the cultivator to use some of the most convenient means that have been proposed to exclude the wasp or kill the worm, until the fallen vegetation is sufficient to defend the tree. Some respectable cultivators have long preserved the life and health of their peach tree by the use of lime alone. This is applied with less risk after it has been exposed to the air long enough to weaken its corrosive property considerably. In that state, a shovelful or about half a peck should be spread on the ground around the tree, and well incorporated with the soil as deep as it may be done without injuring the roots of the plants. Some labour may be saved, by spreading it just before the plants are cultivated by the D hoe or scuffle.

It would seem, however, that a better remedy would be to anoint the body of the tree where the fly deposites its eggs with quicksilver ointment. This is best put on with a small brush, taking care to rub the ointment well into the rents made in the

* Here, being conscious that I am "moving on untrodden ground," and that the result of many a theory equally or perhaps more promising, has been proved to be erroneous, the ground on which I move, seems to shake, although I can see no reason why it should do so, except that practices resting on theory alone, are but too commonly hazardous experiments.

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bark by the growing of the tree. The expense will be very trivial, if the cultivator buy the materials and make the ointment himself.

There is reason to believe that a covering of leaves will prevent the beetle from puncturing such fruit as is commonly injured by it. There are different varieties of the wild plumb growing here. They, however, grow much more plentifully about fifteen or twenty miles distant from this place. The hunters, and others, who traverse our forests, say the fruit is only slightly injured by the beetle. It is, however, very observable, that the fruit growing on the same tree, removed when young from our forests into our gardens, is as extensively injured by the beetle as I have ever seen it in our older settlements.

Now, as Plum Island and other parts not far from this place, seem to have obtained their names from the number of plum trees which the first explorers of the country found growing on them, it would appear, that much more time has been allowed for the propagation of the beetle than would have been necessary to introduce them in immense numbers, if nature had not taken measures that were well calculated to prevent an immoderate spread of those insects, that the fruit might be preserved for the use of the different animals that feed on it. This important end seems to have been accomplished merely by keeping the grounds well covered by the fall of the foliage, &c. from the plants.

Notwithstanding the beetle has been formed to live in the ground while in its grub or worm state, practice and observation have long since determined, that it is not furnished with sufficient powers to penetrate the soil where any very serious obstacle opposes its progress. Thus, we see, that when the cattle, or the farmer's family, or both united, happen to consolidate the ground where the plum or any other tree is growing whose fruit is commonly punctured by the beetle, the fruit is sure to escape any material injury from that insect. The cause of this is well known, and has been attributed in every instance, so far as my observation extends, to the incapacity of the beetle, while in its worm state, to penetrate the hard trodden ground. There is, therefore, nothing unreasonable in supposing it probable, that it cannot penetrate through a mass of dried and compact vegetation. As in this case it can only get into the ground where the wind or any other cause removes the fallen foliage of the tree, it does not exist in sufficient numbers to do any material injury to the fruits where nature solely cultivates the plants. If so, any vegetable substance equally as impervious as the leaves, will prevent any very serious injury from the beetle.

The experiment, however, on a small scale, is easy, and seems to be worth trying. If it should succeed, all fruit liable to serious injury from the beetle may be readily saved by planting the trees sufficiently close to cover the ground by the fall of their foliage, and also to preserve this foliage from being blown off by causing the limbs of the trees to grow very near to the ground in the way that has been before pointed out.

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CHAPTER XLI.

On the sugar tree.

The sugar tree, as it has been spread by nature through our forests, is very useful to the back-woods farmer; especially when there happens to be enough of them so near to his dwelling that he can gather the sap or sugar water, and haul it in casks to be boiled there. This, however, seldom occurs; the farmer, therefore, fixes his sugar camp, as it is called, where he finds the most trees near enough together to collect the sugar water with tolerable convenience.

In the middle of the grounds where the most trees stand, he builds a hut, covered with bark or spruce pine boughs, to shelter him from the weather. Just without the hut the kettles are fixed for boiling the sugar water. This is done by hanging them on a pole supported by crutches. The establishment being thus completed is called a sugar camp.

As the sap commonly commences running while the snow is still deep on the ground, and the way to and from the trees is generally obstructed by fallen timber and underwood, and the sugar trees stand wide apart in consequence of the growth of a variety of other trees among them; this, with boiling day and night while the sap runs freely, together with living in the hut, render sugar making a tiresome and disagreeable business to the cultivator.

As the running of the sap depends much on the weather, and the greater or less exposure of the trees to the influence of the sun and air, the progress is frequently very tardy, and the product as uncertain as the gathering of it is slow. When what are called good or bad seasons for making sugar are averaged, it is commonly considered an unprofitable business, unless the camp stands so near to the farmer's dwelling that he can gather the water without interfering with his other business, and boil it either in his house or yard: therefore sugar trees are not so highly prized as they would be if those difficulties to a profitable use of them did not intervene. They are of consequence often destroyed when the grounds are cleared from their wood. This induces me to believe that in process of time they will be generally obliterated, unless proper measures be taken to make the product much more valuable by being readily obtained. It would seem that this can never be effected unless enterprising and patriotic farmers will set the example of forming them into orchards near to their dwellings. This may be as readily done with the sugar as any other tree, and, if it be considered that ingrafting will be useless, it is evident that

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the labour will be much less. If the plan I have already proposed be adopted, the orchard will require but little cultivation or pruning, and no manure after it has been formed. The wood is at least quite as solid as hickory, burns equally free, and as long: therefore will be quite as valuable for fuel after age has rendered the tree unproductive for sugar. The soil, after the timber has been removed, will not only be fresh but also very rich for the growth of cultivated crops. It should also be remarked, that as the sugar tree is much more curly and vastly harder than the common maple, it is greatly preferable to the latter for making household furniture; that no wood exceeds it for making stocks for guns.

Thus it would appear that after the tree is no longer valuable for making sugar, the timber will command a high price, where that article is in demand. I have, however, been informed that some trees which have been regularly tapped for more than fifty years, are still at least equally as productive as they were at first. It would, therefore, appear we have reason to believe, that an orchard formed of them would be very lasting.

It is rendered difficult to obtain the average product of the sugar tree, as in collecting the water for boiling, the produce of the whole is mixed, and many of the trees from being closely shaded by other trees, or by being not only shaded, but also standing on the north side of hills, yield but little sap. This difficulty is also greatly increased from its being customary to tap all the common maple trees within the bounds of the camp. The water or sap from this tree yields quite as good sugar as that from the sugar tree, but not near so much of it.

There is, however, a man residing not far from this place, who has regularly for six years past tapped two sugar trees, which stand just within the woods, on the side of a very steep hill fronting toward the south. As there are no other trees of this description near enough to be tapped by him, his experiments have been confined to them. They yielded, on an average, twenty pounds weight of sugar annually, beside the molasses made from the sap, after it became too weak to be profitably boiled down into sugar.

As every kind of fruit known to us, yields more abundantly when the trees stand in orchards, unincumbered by other vegetation, there is every reason to believe that if the two trees just mentioned, were thus circumstanced, that the product would be greatly increased. But what seems to be still much more important, is, that the sap will not so readily escape if the farmer be vigilant, when the camp is placed near to his house, and there is very great reason to believe that the escape of the sap is the principal cause of the marked difference, between what is called good and bad seasons for making sugar.

I have observed, by tapping the trees to make the experiment, that so soon as the weather happens to become moderately warm, early in February the sap begins to run. As the sugar makers, however, have in general to go to a distant and ill contrived camp, many of

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them consider it useless to begin, in consequence of any trivial advantage, that might be obtained during the short time which may occur before the running of the sap be entirely stopped by the cold and unfavourable weather, which commonly happens soon after the warm spells which take place early in the season. If, however, the farmer happens to go to his camp when any of the warm spells take place in February or March, it commonly happens that by the time he gets every thing fixed for business the weather changes and becomes so cold, that the running of the sap ceases, and he returns home, before any thing of consequence is effected.

In this way he is frequently baffled, more or less, until the season for making sugar has passed by; of consequence the quantity obtained when the season for making it is generally difficult, seldom affords a moderate compensation for his labour. The cause of the farmer's vexatious disappointment seems to be evident. When the weather happens to be so changeable, nature, as soon as the warm spell sets the sap in motion, is industriously employed in applying it to enlarge the buds, which form the leaves, blossom and seed of the tree.

Now it would appear, that notwithstanding some loss must necessarily occur, when such frequent changes in the temperature cause the sap so often to descend; that if the camp stood near the farmer's house he might very readily gather all the water that could be obtained, during the shorter as well as the longer spells which favoured the running of it. Of course that the loss sustained in consequence of the seasons being very difficult would be far less than that which commonly happens from the present general mode of management.

I am still the more confirmed in this opinion from observing that when the camp is near to the farmer's house, and he can and does begin earlier, and oftener takes the advantage which the warm spells of weather soon present, he invariably makes much more sugar than those who pursue a contrary course; though nothing like as much as I believe he would obtain, if he could only be convinced that the same quantity, or nearly so, of sap, circulates yearly in the tree, and that the principal reason why he obtains so little some seasons, is, that it escapes his vigilance.

The favourable seasons for making sugar, are produced by the weather continuing too cold for the sap to circulate even in this hardy tree, until late in the season. Then if the days be generally warm for the season, and the weather also clear, accompanied by sufficient frost through the night to freeze the surface of the ground, (which commonly happens if the nights be clear,) the quantity of sap obtained from the trees is very great. If the nights, however, happen to be mild and without frost, as well as the days, the quantity is greatly curtailed. This is the generally received opinion of farmers, and is also clearly demonstrated by practice: none of them, however, assign any reason for it. In fact it seems like many other things, beyond the reach of demonstration. A plausible cause might

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be assigned, but then this cause would seem to be opposed to what takes place when the sap runs irregularly.

The seed of the sugar tree vegetates freely, when blown from it on our ploughed grounds; therefore, no possible difficulty can occur in rearing camps of it. The seed may be first sown on beds where the soil is rich, light and well prepared, and the plants be kept free from weeds and properly thinned, until of a sufficient size to be planted in a nursery, from which, when large enough, they may be safely removed and planted in the camp.

This tree will grow on any soil which is rich enough to grow an apple orchard; still we all know that the latter prospers best where the soil is good. As a speedy maturity is equally as desirable in a sugar camp, I would advise the cultivator to select a good grass lay: after manuring it well, and growing a well cultivated crop of maize on it, plant the sugar camp; but not till after the grounds have been well cultivated with the hoe and tined harrow, without turning up the sod or manure. After this, form right angles of twelve feet regularly, by a very shallow furrow with the plough; at each of these angles, dig a hole sufficiently deep to plant the sugar tree; but on no consideration put the plant any deeper into the soil, than it stood in the nursery; in which it ought not to have been planted any deeper than it stood in the bed from which it was first removed. Nature best determines the depth the roots of every tree ought to take, and knows full well, even when the seed is scattered on the surface, how to cause the roots of the plant to dip as deep into the earth as they should go. If the hole made for planting be dug no deeper than has been directed, the manure at the bottom of the sod will not be disturbed. It should, however, be made sufficiently wide to give room for the roots of the plant to be spread abroad in the same position as they stood in the nursery. Great care ought to be taken to plant the tree, so that the same sides of it as fronted north and south in the nursery, should do the same in the camp; otherwise the growth of it will be retarded, until nature has altered the economy of the plant to suit the alteration in the position of its sides.

It will be improper to trim the trees, either before or after they are removed from the nursery, further than removing suckers or useless and injurious sprouts; on no consideration should the main shoot which forms the top of the tree, be cut off or otherwise mutilated. Money or labour is never more profitably expended, than in staking and securing trees; it is, however, seldom effectually done, although it is clearly seen, that the action of the winds on the top of the tree, keeps the roots in such perpetual agitation, that it is long before they become established in the ground. This greatly retards the general growth of the plants, and very often destroys many of them. Two stakes should be driven very firmly into the ground opposite to each other on opposite sides of the tree, but so as not to injure the roots of it. A strong twisted band of straw ought to be extended from one stake to the other, also wrapped

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round the tree in that way which is best calculated to keep it from being removed in any direction by the winds.

The D hoe, together with the hoe and tined harrows, used as before directed, will keep the soil free from grass and weeds, until the shade from the plants and from the foliage growing on them, together with the fall of the leaves, render it impossible for grass or other injurious vegetation to grow in sufficient quantity to injure the trees. After this all cultivation should cease. A fence, however, sufficiently close, particularly near and at the bottom, must be erected around the camp to prevent the leaves from being blown off by the winds. The fallen vegetation, and the animal matter introduced by it, together with that introduced by the living vegetation, will supply sufficient manure, and keep the soil open and mellow for the roots of the plants.

The close planting is intended to produce these valuable effects earlier, and in doing of this to save much labour. The supernumerary trees may be cut out and sold, at the time which will best further the growth of the remaining plants; this, however, should not be done, until injury was not to be expected from letting in more sun and air to the plants than could be readily avoided. If one-half the trees be thus cut out, the remaining half will form a camp, in which the trees will stand twenty-four feet apart at right angles. It can, however, be only known by actual practice, how far the sugar trees when formed into a regular orchard should stand apart; still it is believed that twenty-four feet may be safely considered as the proper distance, until practice has more correctly determined what the distance ought to be.

Here I beg leave to observe, that if double the number of apple or other grafted fruit trees, were planted in the commencement of planting an orchard, be the ultimate form of the trees what it may, the product would be greatly increased, from the time the trees began to bear, until it became necessary to remove the extra number. The wood of the apple tree is very valuable for fuel, and also for some other purposes; consequently would sell for more money than the increased expense arising from this mode of management.

But to return to the sugar tree; I believe it is seldom tapped in our forests when it is less than six inches in diameter; no information of mine will therefore determine how small they may be profitably tapped. As no injury, however, can arise from tapping such as the cultivator means to remove, I would advise him to make the experiment on those trees when they have attained three inches in diameter. If the tapping of them progressed regularly year after year, it would determine whether removing the sap injured the growth of the tree, and also the extent of the injury, if any there should be.

The foliage of the sugar tree is handsome. An orchard or camp formed of them would add greatly to the beauty of a farm; especially as a conviction of profit and utility would add much to the native beauty of the plant. Like a hedge, however, or an apple

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orchard it will require some time to bring a sugar camp into active use; I therefore fear that my labour so far as this invaluable tree may be concerned will be in vain.

The sugar tree prospers where the ground is moderately dry, and is also seen growing where it is very wet; still they generally stand much thicker where the soil is rather inclined to be moist, as often happens on our highest hills here; this moisture, however, is seldom very obvious, until after the grounds have been long enough cultivated without attention to grass or enriching manure, to exhaust much of the vegetable matter that abounded when they were first cleared from their wood, I would therefore advise the farmer to form his camp on grounds which are moderately retentive, if such are to be found near to his dwelling house. If, however, I were now living on the farm formerly occupied by me, near to Philadelphia, I should not fear the result of forming a sugar camp on any part of it, notwithstanding the texture of the soil differs widely. Nay more, I should have but little doubt of these trees succeeding well in the sands that form the shores in New Jersey, opposite to Philadelphia, provided these sands were thickly set in grass, well manured, and but one crop of maize grown on them, previously to planting the sugar camp.

As I write where I can neither refer to books nor men for information of the probable product of an acre of sugar cane, well cultivated, in a soil and climate favourable to the growth of it, it is impossible for me to determine the comparative product with that of an acre of sugar trees.

The difference, however, in the amount of the produce, must be very much in favour of the cane, or the neat clear profit arising from the sugar tree, will be the greatest. The sale of the timber, after the tree becomes too old to be profitably kept for making sugar, must more than defray the expense of rearing the plants, and the rent of the soil, before the camp comes into active use. A simple operation obtains the juice, without the aid of slavery's hoe; or the tormenting lash of merciless drivers; or the costly machinery and additional labour necessary to compel the cane, after it has been expensively cultivated, to part with its juice.

The molasses made from the sap of the sugar tree is much better than we import from the West Indies, and infinitely clearer. As this is commonly obtained from the last running of the sap, it seems to be an extra profit. The drainings of the sugar also supply an excellent and clear molasses when care is taken to preserve it. No question but a spirit equal in quality to any made in the West Indies, may be obtained from the juice of the sugar tree. I have never seen whiter refined sugar than that made of the brown sugar, from this plant. One very great advantage derived from the cultivation of this tree, is the certainty of its proceeds not being contaminated with the great and disgusting quantity of decaying animal matters necessarily mixed with the product of the sugar cane. The latter is gathered when animalcula of every kind prevail; the

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former, before they predominate to any extent that would claim serious attention.

Enough has been published on the methods pursued in boiling, clearing, graining and draining sugar, to render any thing further on that head useless: especially as the processes employed in making sugar, are so very simple, that care and cleanliness seem to be the principal necessary accomplishment of a sugar boiler. It may, however, be proper to remark, that the great waste of fuel in boiling sugar in the back-woods, where timber seems to be in the way, renders even the cutting and carrying of it to the boilers, expensive, if labour be estimated. It is, therefore, evident, that if sugar camps be planted in the older settlements, the kettles should be fixed in brick or stone work, with enclosed fire places so constructed as to consume the least possible quantity of fuel. If the sugar be boiled in this way, very little fuel will be necessary, provided the fire places and flues be well constructed. A slight house or shed, with proper flues to carry off the smoke, will make the business comfortable and convenient to those who do the work.

Cast iron kettles are exclusively used here for boiling. It looks equally as well as any imported sugar when well made, although I have never known of its being cleared in this neighbourhood, with any other article than eggs and new milk, and a little of either seems to answer the purpose: more especially, when used by those who preserve a proper attention to cleanliness, which seems to cost but little extra labour, as the attentions necessary to have every thing in complete order, seem to be few and extremely simple. Copper or tin utensils are known to be unhealthy, unless used with much care and attention, I would, therefore, advise them not to be introduced in making sugar. Troughs are used in this woody country, to receive the juice which runs from the spiles. Where timber is not an incumbrance, common earthen pots, with ears, will be cheaper and much better, as any kind of wood, while the troughs are green and new, will communicate a more or less disagreeable taste to the sugar. Some woods are very injurious to the taste of it. The troughs also very frequently crack open and become leaky. As the surface of a trough is much wider than that of a pot, fewer impurities will accumulate in the latter.

A low wheeled cart to carry a tight cask around or through certain parts of the camp, as the case may happen to require, to receive the sap from the pots or troughs, would save much labour. The sap will also be much less wasted than happens when it is carried by hand, in buckets, to the place where it is boiled. Very large troughs are generally made of the trunks of trees, to receive the sap when it cannot be boiled, so fast as it runs from the spiles. As the farmer's cider casks, however, are mostly empty before the time for making sugar comes on, these will be found better than troughs, provided they be made very clean.

I will conclude this subject by remarking, that it appears clearly, from what is known of the economy of the sugar tree, that any cli-

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mate which furnishes either in the winter or spring, moderately warm days, succeeded by frosts hard enough to freeze the surface of the ground at night, is calculated to grow that tree, with much more profit to the cultivator, than any plant that he can rear and sell, to purchase his sugar from foreigners; that as habit has made this article an actual necessary in our general mode of living in this country, we ought to make it ourselves; especially, as the high price of it, occasioned by the late war, clearly shows the great advantage of being independent of other nations for articles that our own soil and industry will always furnish at a lower price. There is also another powerful motive which ought to induce every farmer to make at least as much sugar as is consumed in his family, as he may do it at a time when the general concerns of his farm are by no means pressing on him, and with but very little labour.

It appears that those parts of the United States where the sugar tree will prosper, may very readily make, without interfering with their agricultural concerns, more sugar than will supply the consumption of the whole Union, even if this article was not made from the sugar cane, in those parts of our extensive country where that plant prospers.

Since writing the above, Mr. O'Keath, a gentlemen who resides near Ebensburg, in Cambria county, informs me that nine years ago, he took up in April, three hundred and fifty plants of the sugar tree, which are growing very plentifully in his neighbourhood, and planted them on a plum bottom, on lands which he owns at a considerable distance from where he lives, and on which no sugar trees grow. It is now twelve months since he last saw the plants. At that time they had grown to be as thick as his leg, although no care had been taken to remove the native plum trees, when or after he planted the sugar trees among them. The distance, together with the means of transportation, induced him to select such as were very small.

Every person with whom I have conversed respecting the growth of the sugar tree, agrees in saying that it grows very fast when not shaded by large forest trees. One of my neighbours, in whom I can confide, informs me that when he made his clearing nine years ago, he observed a young sugar tree, which at that time was scarcely as thick as his finger; that he has often noticed it since, and that it is now full as large, if not larger than his thigh.

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BOOK IV.

ON GENTLEMAN FARMING:

ALSO,

ON CIRCUMSCRIBED FARMING;

OR THE BEST MODE TO BE PURSUED, WHEN THE CAPITAL EMPLOYED IS INSUFFICIENT TO FARM TO THE BEST ADVANTAGE.

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CHAPTER XLII.

Observations on the causes which have increased gentleman farming. Their expensive establishments considered.

The frequent recurrence of the yellow fever in our seaport towns, compelled multitudes of the citizens to take refuge in the country. This created a taste for rural pursuits, and induced numbers (whose finances did not well accord with it,) to form country establishments. As it was too generally supposed that an addition of land for farming, would lessen the expense, this still more injurious plan was adopted by many; and immense sums of money wasted in a business, with which they were entirely unacquainted.

Other gentlemen, who have either by their own industry, or from inheritance, acquired handsome estates, become tired of the business or pleasures which are pursued in towns. Citizens of this description, generally keep carriages for the recreation of themselves and families, and their excursions into the country, are commonly pleasant relaxations from their pursuits in town. This prepares the mind to be infatuated with rural economy; especially, as the grounds in the vicinity of our larger towns have been enriched and improved with more taste and skill, than generally takes place elsewhere. Luxuriant crops, with numerous flocks and herds, are seen in every direction.

Poets, with other writers, attribute to rural pursuits, all the rational pleasures which constitute the chief happiness of man. In doing this, they, however, appear to have forgotten that these beautiful scenes which they so elegantly describe, are the effect of immense labour and fatigue.

The gentleman whose imagination has, in all probability, been excited by recollecting some of the most appropriate passages from these authors, appears also to forget, or not to know, that agriculture, when properly pursued, under the most favourable circumstances, requires very great attention, both early and late; and that there are very few employments which have more crosses, losses and disappointments, necessarily attached to them. An epidemic sometimes sweeps off live stock, as with the besom of destruction. If this does not happen, all animals are liable to disease or accident, and a considerable portion of the farmer's stock is vested in them. Mildew, smut, with numerous blights, also excessive rains, storms, a scorching sun, drought, untimely nipping frosts, and insects, (which are sometimes as destructive as an invading army,) destroy the farmer's most flattering expectations.

However, the gentleman seems to expect rest from all his labours, when he commences farming. Every jaunt into the country

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confirms this sentiment, and he returns with increased reluctance to the smoke, dust, bustle and putrid effluvia of the city. These annoyances appear to be greatly exaggerated by his heated imagination, and every succeeding excursion increases the delusive expectation of happiness in rural pursuits; which, saying the least of what may happen, will certainly doom a few years of the gentleman's life, to continual perplexity, unless his conduct in the country be governed by much caution, and a very uncommon share of prudence. Farming, as it is now practised, (especially by those who depend principally upon books,) is a very complex business, and if this science were stripped of its complicated absurdities, and reduced to a perfect and simple system of management, still, as it is only by practice that we become intimately acquainted with the most simple employments, it would seem that the gentleman ought to serve an apprenticeship with some distinguished farmer, before he embarks on his own account, in a business with which he is entirely unacquainted. Certainly, if he be a merchant, he would not trust the command of his ship to any person who had never been at sea, although he might believe him intimately acquainted with the theory of navigation. Yet I believe it will be found at least equally hazardous for a gentleman who can command a plenty of money, and possesses a generous disposition, to encounter a farm without practical information, unless his theoretical knowledge be founded on principles, which are consistent with his peculiar situation, and he has sufficient firmness not to deviate from them. As this, however, has seldom, if ever, occurred, and it is impossible to say what may happen hereafter, I shall proceed to describe what has but too frequently taken place heretofore.

When a gentleman wishes to commence farming for the purpose of getting rid of the troubles and vexations of the world, he generally resorts to books for information. These clearly and very justly convince him, that full bred farmers do not generally manage their agricultural concerns, any thing like so advantageously as might be done: also that much greater profit might be readily obtained, if farming was properly conducted. Firmly believing in these books, and that they have, at least, taught him the rudiments of agriculture, he resolves; and the farm is bought without duly observing, and of course without sufficiently considering, that the different opinions of the authors, give contradictory theories; consequently he has actually to learn, from his own practice, which of them is right; or whether the whole of them may not be essentially wrong, in many cases in which his prosperity may be highly interested. Such information as this in the hands of a zealous novice, is something like a sword in the hands of an enthusiastic revolutionist, who does not distinguish between the rational principles of liberty and licentiousness. If the practices recommended by writers on agriculture, were always accompanied with a clear explanation of the beneficial causes brought into operation by them, the gentleman farmer, even in the commencement of his business, would be much

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better enabled to determine their probable merit by comparing them with practices recommended by other writers on the same subject: especially as it may be laid down as a maxim in farming, that no practice can be proper if it be opposed to reason. It is therefore to this faculty that every writer should apply his subject. If this be not done, the reader has either to supply the defect by his previous knowledge of the subject, or to remain ignorant, further than bare assertion goes. If he should act on the faith of this, he may be egregiously disappointed, as the patient who swallows the pills, powders, or anodynes, of an ignorant quack who invents specifics to cure, and also to prevent, every disease in nature, and boldly offers them to the public, (and but too frequently with success,) although the causes which produce these wonderful effects remain a secret not only to his credulous customers but also to himself. This is equally applicable to the plain, practical farmers, who for the most part are greatly opposed to books on agriculture, for which I now believe (though I once thought otherwise) they have been too severely censured.

This prejudice seems to arise from their being too often disappointed by the promises of great profit from practices which were better calculated to ruin them than increase their revenue, for it must be confessed that but too many of this stamp have appeared. They have either been predicated on elaborate calculations founded on erroneous principles, or on certain rounds or courses of crops, as if the interest of agriculture was to be promoted by the means taken by writers on cookery, who furnish receipts to compound dishes agreeable to every palate, as well as to suit every possible occasion that may happen, from a wedding and christening to a death and funeral. The self-taught Kliyogg, or the Rural Socrates, with many other instances, should teach writers on agriculture, that nature is not partial to any grade or society in the distribution of talents: consequently, that common farmers are very far from being so stupid as too many have represented them to be. If subjects calculated to promote their interest were properly applied to their reasoning faculties, they would be as capable of reasoning on plain, practical facts, as the learned.

But to return. So soon as the gentleman takes possession of the farm his trouble commences. The previous habits of a family from town seem to be immediately opposed to the simplicity of rural economy. The dwelling house may be sufficiently large, also warm in winter and airy in summer: still, his family or himself too often discover that the floors have been formed with broad oak or pine boards which have too many knots in them. The chimney or fire places are too large, and being without either marble hearths or jambs, are intolerable: the ceilings are too low, and the plastering has become scaly from frequent whitewashing, and cannot be made to look well; the windows are entirely too small, and small glass divided by too much wood in the sash excludes the light; the staircases are confined, and the height of

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the steps will fatigue the family. A single row of small glass, placed over the top of the front door, had been found sufficient to light the former farmer on his way up stairs, or to enable him to find a bag or any other thing deposited in the entry. The gentleman's family, however, cannot grope in the dark; and, besides this inconvenience, the large door posts seem better calculated to support a gate than the front door of a gentleman's house. The steps leading from the door, in place of being marble, are made of free stone; the height of them is quite too great, they extend but little on either side of the door; and, as the last step terminates at the bottom of the door, still there is no platform in front.

A consultation is held, and frequently ends in the condemnation of a convenient and very useful house, well calculated to promote the future ease and tranquillity of a rational farmer; and it too often happens, (even when the gentleman cannot conveniently spare the money,) that the building is completely gutted and modernized, or appropriated to accommodate the hired farmer or head man and his family, and a new one is erected for the master.

If the gentleman determines on the latter, he acts wisely, as after much money has been spent in altering even an excellent house, that has been built to suit the convenience and finances of a plain, practical farmer, it is but a botched piece of business at last; however, in either case, the money commonly expended does not accord with any rational estimate of the income that may be derived from the farm.

But what makes the matter still worse, the alterations and amendments too seldom stop at the mansion house. An ice house, with various other buildings and conveniences which a plain, practical farmer seldom thinks of erecting, seem to be considered necessary to the establishment of the gentleman farmer.

These things in detail appear to be trifles, but a very serious expense occurs before they are finished, as they are commonly erected on the most approved plan, and too often expensively ornamented. The garden is seldom found sufficiently large or properly arranged. It is therefore considerably enlarged and properly laid out and regulated, the walks graveled, and a green or hothouse too often erected, where the ornamental and useful exotics of southern climates are abundantly introduced. Besides the pleasure arising from seeing, displaying and using these rare productions of nature, it is probable that the gentleman has been led to believe, from observing that the nursery men obtain very high prices for those plants, than his gardener and market man may readily dispose of the increase arising from the original stock to considerable advantage. Summerhouses are also built so as to adorn the premises, and secure a pleasant retreat from the rays of the sun; and if there be any stream which favours the project, a fishpond is too often made.

The plain, practical farmer has commonly before his door a yard of a moderate size well covered with grass. This, with the bor-

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ders round the beds in his garden, are often decorated by his wife and daughters with the common but interesting flowers and shrubs generally employed in the country for this purpose. These, with the adjacent fields, (if they happen to be well cultivated,) display the genuine features of rural simplicity. The attention necessary to this simple but lovely establishment, requires no more labour than the leisure time that can be readily appropriated to it without interfering with the business that should be done either in the house or on the farm. As the human mind craves, and, if it be possible, will have amusement, it would be difficult to devise one that would be more rational, interesting, or innocent than this.

But this simple system of economy too seldom accords with the views of the gentleman farmer, and several acres of an adjacent field are added to a yard, which is now called a lawn. This is laid out in proper form with graveled, serpentine walks, wilderness, &c.; also decorated with ornamental trees and flowers, which are readily obtained, when money is plenty, from the nursery men in the vicinity of the town.

Although the former farmer may have had a sufficiency of fruit to supply his family with a plenty of it, cider, brandy, &c. and the residue being carefully gathered by himself and his family and taken to market, made his garden and orchard profitable to him, the gentleman too frequently discovers that the fruit is not of the most approved kind: therefore orders are sent to the best nursery men for trees, bushes, vines, &c. of every description, that are the most valuable.

The barn and other out buildings are too often considered inconveniently constructed; they also undergo extensive alterations, or new ones are erected on a proper plan. Marble has been used in some parts of these buildings, and much ornamental work employed in the construction of them.

It frequently happens, that notwithstanding the fencing was sufficient, with some little mending, to have secured the former farmer's crops for some considerable time to come, they are subjected to an expensive repair. If there be any worm fencing, it is generally condemned, and post and railing put up in its place.

The roads through the farm are often considered inconveniently situated, and others are made where they should be. As time has worn off the soil from the old roads, they are filled up with rich mould. Gullies and sometimes quarries in the fields are also filled up, and the surface enriched to promote vegetation. Inequalities in the surface of the soil have been leveled through the fields. Open and under drains formed where springy or boggy places appear. Stumps are hoed up by the roots. Rocks blown and removed, and the space occupied by them filled up and covered with good soil. Ditches are sometimes formed between the fields and the woods, to cut off the communication of the roots of the trees, so that the crops may not be injured by them.

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The gentleman is commonly careful in the commencement of his career, to collect every implement of husbandry; and too often adds others that are highly recommended by books, which also furnish engravings of them, from which he gets them made, but too commonly not without much trouble, perplexity and expense. Of this, however, he does not complain; being clearly convinced that the agriculture of this country is very imperfect, when compared with that of Great Britain, which he resolves to imitate in his practice. But notwithstanding his very laudable and patriotic intention, it generally happens that his workmen do not know how to handle these outlandish tools, and having a mortal hatred against every thing that is new, unless they be convinced of the utility of it, they designedly, (but as if by accident,) break them against some unlucky stump, stone or gate post; being determined not to puzzle their brains with learning the use of them, and very unfortunately the gentleman is incapable of instructing them: therefore, after much time and money have been spent in fruitless attempts to bring them into use, they are finally laid aside, until they are better understood. If this should never happen, the purchase money is also lost.

A plenty of working horses and oxen is purchased, and of the best quality, provided the highest price can certainly effect this purpose. It being generally determined to breed from the best stock, bulls, cows, rams, ewes, &c. are selected from the flocks and herds of the most approved breeders. The breeders soon discover the talents of the purchaser; and the gentleman seldom fails in procuring the best stock the country can afford, if very exorbitant prices enhance the value of the animals. Price is too generally a secondary consideration with him; especially if he be determined to excel at the cattle shows, and also to send to market the first rate butter and cheese. It is too often believed that his books furnish him with receipts which will enable him to effect this purpose. Of the cattle show, I know but little, having never been there. I do, however, know that the gentleman ought to have considered that although his receipts may be excellent, and his ingenuity equal to reducing them into actual practice, a dairy requires in this country the laborious attention of the mistress of the family. The previous habits of his lady render it impossible, without risking her life, for her to stand over her shoe tops in mud or dung, or half leg deep in snow, until the cows are milked, and after this, to see that the most trivial thing belonging to the management of the dairy is properly done, even to slopping the cows and feeding the pigs. If this be not done, or the gentleman be not more fortunate than common, every thing will be mismanaged; and his fine stately cows will soon become dry. Therefore, in place of selling butter and cheese, he will have the mortification of depending on the plain practical farmers around him for butter, more than half the year; and his cheese, if any should happen to be made, will never be fit to appear at his table.

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Although the gentleman expects much future improvement from the manure which will be made by his extensive stock, still, he is seldom unmindful of the present time, and his carts are busily employed in bringing large quantities from the city. It, however, too seldom happens that he is acquainted with the quality of manure, and his carters find it much easier to load, and also to haul such as consists principally of straw. This actually reduces the value of it more than one-half; so that every cart-load which costs the plain practical farmers in his neighbourhood, after it is hauled, two dollars, commonly costs the gentleman four or five dollars, if the real value in place of the bulk be estimated. Although the gentleman intends to farm much better than they do, this single but serious slip in the beginning, seems to place him so far in the back ground, as to render the contest at least very doubtful.

If, in riding the roads near to one of our cities, we happen to meet a cart filled with long strawy dung, and ask the driver for whom he is hauling it, we generally hear that it belongs to some gentleman farmer.

Having gone through the long and expensive catalogue of the gentleman's improvements for the accommodation of his family, and his preparations for farming, I will, in the next chapter, make such remarks on the different subjects, as I believe may be useful to this highly interesting, but too often, very mistaken class of farmers.

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CHAPTER XLIII.

Remarks on the gentleman's country establishment, and a more economical management proposed.

I WILL now make my remarks on what has been advanced in the preceding chapter.

Until the gentleman's buildings are so far finished, as to afford a tolerably comfortable residence for his family, they generally continue in town; consequently his visits to the farm are transient; and having collected together masons, carpenters, painters, &c. with the necessary labourers to wait on them; also gardeners, with workmen to assist them in forming the garden and lawn, and to plant a vast number of trees, shrubs, bushes, vines, flowers ,&c; likewise fence makers, ditchers, blasters, ploughmen, carters, and labourers to do the business on the farm; the wages and provision for such a host must cost an immense sum of money. When the wanton waste, depredation, and idleness, that naturally take place, where no care can be taken, and every person follows the bent of his own inclination without restraint, are considered, it is reasonable to suppose, that on an average every thing that is done, costs him two or three times as much as it ought to do, especially as many of the people in the vicinity of our cities have been accustomed to prey upon gentlemen farmers, and know full well how to practise every species of deception and chicanery to effect this purpose; and as the gentleman's head man or farmer is but too generally on a level with them, he commonly finds it contrary to his interest or inclination to expose their faults.

If the gentleman should finally get tired of farming, as too commonly happens, in consequence of saddling it with a useless and enormous expense, he will soon discover that what he has expended over and above useful improvements is lost. Useless brick, mortar and lumber, united with every expensive ornamental work, form no part of the estimate made of the value of the premises by a prudent purchaser. He knows full well, that no profit which can be derived from farming, will pay him an interest on it: also, that the necessary repairs of the extra buildings will be a continued tax on the farm, unless he leaves that part of them to be inhabited by cats and owls, which would be unpleasant to those who like to see every thing round them in good condition. It will likewise be found that the ornamented grounds, which cost the gentleman so much money, and subjected him to so much fatigue and perplexity, will be more likely to diminish than increase the value of the farm. The judicious purchaser will calculate that if they remain as they are, the rent of the land is lost; also, that unless he submits to the annual

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tax of keeping them in order, the whole, in place of a part, will become a wilderness, and spoil the appearance of his farm; therefore expensive alterations must take place, before the obstacles which folly has placed in the way of cultivation can be removed. The trees and shrubs must be grubbed up, and the gravel and other trash opposed to vegetation removed, before the grounds can he profitably employed.

Whereas if the gentleman had properly considered the subject, his own good sense would have informed him, that no art of man, aided by all the beauties of nature, could possibly decorate the grounds round a farmer's house, with any variety half as interesting as luxuriant crops judiciously cultivated. The beautifully green headlands around his fields, when mowed for the cattle while the grasses are still young, would form a useful and interesting carpet, adorned with the small and simple flowers of the season, furnishing extensive walks and scenes truly in unison with rural simplicity, and the economy of farming, as well as honourable to the taste and good sense of the owner, especially if he be actually very wealthy, and might without the least inconvenience possess all those expensive and useless toys which are so well calculated to divert little minds; such a gentleman farmer would do honour to his profession, for his example would not tempt other gentlemen in his neighbourhood, who were less opulent, to injure their finances by aping his splendour, or else induce them to avoid an intimate intercourse, lest the happiness of their families might be blighted by the creation of artificial and useless wants.

It may, however, be proper to observe, that if the gentleman possess a princely estate, and has resolved to live in style, it is certainly no business of mine; still, as he professes to admire agriculture, and wishes to promote its interest to the utmost of his power, it would be unpardonable in him to saddle it with expenditures, entirely inconsistent with the economy of farming, especially as this may be readily avoided.

I therefore beg the liberty of proposing what seems to be a rational plan, and one well calculated to gratify the gentleman's ambition, without injuring the reputation of gentleman farming: provided he is not so engrossed by other pleasures as to prevent his personal attention, both early and late, to the business of the farm. Unless a gentleman be as fond of agriculture as a sportsman of his dogs and gun, he cannot possibly derive any more pleasure from it than the latter would do by keeping guns and packs of dogs for the use of those whom he had hired to procure game for his table, and to kill the foxes in the neighbourhood, when he knew that money would do this with much less trouble and expense, and that he loved his ease too well to derive any pleasure from such fatiguing sports.

Now we all know that the sportsman is indefatigable, and that his pleasure arises from active pursuit. He will rise long before day to join the chase in time; leap fences and ditches, and ride at

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full speed through the woods. If he happen to fall from his horse, and his limbs are not dislocated, he eagerly remounts and pursues the hounds with redoubled activity, until he regains what he has lost by this temporary derangement: nor does he wait to shake off the dust, or scrape off the mud from his clothes; and if his hat be not readily found, a handkerchief quickly supplies its place, and he hies on without it. Such choice spirits as those are exactly calculated for gentlemen farmers, provided they are really interested in the pursuit, and are resolved to be governed by the genuine principles of rural economy, and their previous habits have taught them the inestimable advantages that may be derived from observation, reflection and calculation; for, on the proper exercise of these invaluable principles, the prosperity of gentleman farming principally depends.

When a gentleman possessing these qualifications has purchased a farm, and is determined to live in style, I would advise him to lay off a sufficiency of ground for the necessary buildings, park, lawn, garden, fishpond, &c., and to charge this, with every improvement made on it, to "Family Establishment," and the remaining acres to the farm. As the taxes will, or ought to be, considerably increased in consequence of the expensive building, &c. erected for the family, he should be careful not to burden the farm with more than its just proportion of them. As his steward, butler, huntsman, gamekeeper, groom, coachman, and servants under them, together with his housekeeper, chambermaids, nurses, waiters, cook, scullions, &c. will have much leisure, he should draw a positive line of demarcation between these respectable inhabitants of the castle and plebeians on the farm; otherwise, the latter will become very restive and troublesome to him. They will murmur loudly against hard labour, while others, whom they will most certainly consider no better than themselves, are well paid for lolling a considerable portion of their time in the shade: more especially as they do not partake so freely of the delicacies from their employer's table, nor have the same opportunity of visiting his store rooms and cellars.

I would also advise the gentleman to keep a *will* always ready made, ordering the separate sale of the "Family Establishment," and of the farm; lest in the last act of his life he might disgrace gentleman farming. If both should happen to be sold together, the world (which in cases of this kind seldom if ever discriminates properly) will attribute the enormous loss arising from the sale to gentleman farming. If, however, the *will* be made, the gentleman may have the satisfaction of feeling easy on his dying pillow; at least so far as agriculture may be concerned: for his farming accounts will clearly demonstrate to the world, that after the farm has been charged with its first cost, and every necessary rational improvement made on it, that it is actually capable of producing a neat, clear annual income of at least ten per cent. on the aggregate amount, and also a like interest on the capital necessary to

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carry it on: even after full allowance has been made for wear and tear, and also for the depreciation in value of horses grown older in his service, together with every necessary repair done to the buildings, fencing, &c. This is not all; for, although temporary depreciations in real property will occur from various causes, it is a well known fact, that, on the whole, its value increases with the increase of the population and prosperity of the country. It will also be found, if the gentleman has managed judiciously, that one acre of the soil, taking the whole on an average, will produce more than three acres did at the time he purchased the farm; unless, indeed, it was at that time more highly improved than farms generally are. For talents, capital and industry are capable of effecting an immense improvement in the soil, in a much shorter time than the probable existence of purchasers in general.

A gentleman should have all his buildings finished before he removes to the farm. The whole ought to be erected by contract; the undertakers finding all the materials. If this be done, they will seldom cost half so much as they would do in the usual way. Much trouble and vexation will also be avoided, as his only care will be to observe that the business is properly executed.

The gentleman will also find it much to his interest, when it is practicable, to have his mowing, reaping and cradling done by the acre, and his corn fodder cut and gathered in the same way; his manure hauled out to the fields by the load, of so many cubic feet in each; his grounds ploughed and harrowed by the acre, himself or the contractors finding the teams; ditching done by the perch, and fencing by the pannel; wood chopped by the cord, and hauled in the same way; corn husked and cribbed by the bushel; it and other grain threshed in the same way; removing stumps, rocks and other obstacles by the acre or job; clearing woodlands in the same way. The undertakers should either find their own board, or pay for it when they are not working,* as this will not only lessen the expense, but also stimulate them to more industry.

No live stock should be purchased, or any crops cultivated by the gentleman, until he removes to the farm. It is ten to one but the former will be so much neglected through the winter that they will not sell for as much in the spring as they cost in the fall, although much money has been expended for food and attendance on them. It is also more than probable, that crops grown at his expense during his absence or transient visits to the farm, would not sell for half the money they cost.

But as it is of the utmost consequence to hasten the improvement of the soil, and also to provide sufficient food for an extensive stock of cattle, the fields which are not in grass should be let out on shares to the farmers in his neighbourhood to be sown in small grain: either on one or more ploughings, as may best accord with

* Disputes and complaining, however, would be better avoided by charging them a moderate price for board the whole time the job is in hand, and paying them more for doing the work.

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the views of the cultivator. On these grounds red clover ought to be sown early in the spring. If gypsum be sown on them, hay and pasture will abound. The grounds may be rough, and weeds too plentiful; still, this is of but trivial consequence, when compared with the great advantage which may be derived from this invaluable practice.

It was by these means that the very rapid improvement was effected on the farm, in the vicinity of Philadelphia, formerly occupied by me.

I would advise the gentleman, even if he should remove immediately to the farm, to put out on shares, all the fields that are not in grass, and which may not be wanted for the commencement of his first course of crops.

These should be very limited until he becomes better acquainted with farming. This will enable him to execute the little he undertakes, with more care and skill: also prevent the heavy losses, that but too often arise from gentlemen aiming at too much in the beginning. This is not all; for but very light crops of grain are to be expected from a hasty and imperfect cultivation of a thin soil; especially when conducted by a person who has not sufficient information to employ every favourable circumstance to the best advantage; consequently, if he should only get the straw for his share of the crop, it will be better than to risk the cultivation of all the fields himself; but it is probable he may make a much better contract than this. Here it seems proper to remark that, although it may be found necessary to meet the views of the farmer, to admit him to plough more than once, it is not only less expensive, but also far better to sow on but one ploughing, as the animal and vegetable matter is far better secured from useless waste; and unless the grounds be often ploughed, harrowed and rolled, a smoother surface for mowing the clover is generally obtained by one ploughing than more, if the furrow slices be well turned, and leveled by the roller, previously to harrowing and sowing the small grain.

The produce of a highly improved and well cultivated farm, is very great. If extensive barns and other buildings, sufficient to store the whole of these bulky articles, be erected in the plainest, but at the same time, in the best way, together with only such a dwelling house as is commonly built by the plain, but wealthy Pennsylvania farmer, the whole will amount to more money than the estate will bring, unless a favourable opportunity offers when it may happen to be sold. As the rise in the price of land frequently covers the loss, this serious evil is too seldom seen or considered. This, however, is not all, for the interest and repairs on the multiplied mass of building, will amount to a considerable sum, and is a yearly tax on the farm. When, in most instances, simple and cheap conveniences, would secure the crops better from waste, and also furnish preferable shelter for live stock, where they might be fattened with much less labour. England, though vastly too

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expensive in her agricultural pursuits, (since it has become fashionable for gentlemen to farm in that country,) is much more economical in the erection of farm buildings, than Pennsylvania, and in fact ought to be.

If it costs the owners of lands in England, as much for farm buildings, in proportion to the surface of the soil, as it costs too many Pennsylvania farmers, they would be entirely ruined. Here we very frequently see large piles of building erected on not more than from one hundred to a hundred and fifty acres of land, though the average product per acre, falls considerably short of that of Great Britain; when if half the money expended on useless stone and mortar, had been judiciously laid out in live stock and the improvement of the soil, the product would be at least equal, for our soil is naturally as good, and our climate is vastly more favourable to vegetation than the climate of England. Now if it be a fact that the plain practical farmer is seldom remunerated for erecting very extensive, but plain buildings on a farm, it consequently follows that gentlemen farmer's extensive and splendid establishments, must be very injudicious, as well as injurious to themselves, and the interest of gentleman farming.

Regular and well formed fences look well, and of course should be preferred when the old ones are actually worn out; provided they are equally good, and not more expensive than others that will answer every purpose quite as well. The use of a fence is to defend the field. Beauty should never supersede economy in the practice of farming. Where land is cheap, and timber an incumbrance, a fence made by heaping up the logs, though far from being handsome, should be preferred; especially by gentlemen farmers, for they ought to patronise economy in their neighbourhood. Such a fence is formed by materials which must be removed before the grounds can be cultivated.

A sufficiency of them may as well be heaped up for a fence, as heaped and burned on the clearing; particularly as they are lasting, and may be readily repaired by the falling timber, and are, if well made, the best defence. Even the falling of the adjacent trees does not break them, neither can any domesticated animal jump over or break through them. If sheep or hogs climb over them, a little brush laid on the top, will effectually exclude those intruders. The logs, as is too often done, should not interlock the whole length of the fence. In that case, if the fire, which is often employed by the back-woods farmer, communicates to the fence, it is very difficult to stop its progress by removing a part of the logs. Therefore, the farmer should be careful to heap the logs in certain parts of the fence, so that they may be readily removed aside, to put a stop to the progress of the fire. In these places, the logs should be sufficiently light to insure the ready removal of them, if there should happen to be but one or two persons on the premises, when the accident takes place.

Altering roads is an expensive business, for the soil is worn off from the old ones, and they ought to be sufficiently enriched to

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promote vegetation. When they are actually badly contrived, it should be done; however, not until the gentleman has become sufficiently acquainted with his business, and also with the premises, to enable him to do it properly, and without useless expense.

I believe the gentleman will never be paid for filling gullies and quarries, if it be done off hand, and that he who does it, either injures his profession, by setting a bad example to his neighbourhood, or subjecting himself to the ridicule of it. But if he lay suitable materials across the former, in proper places to stop the washings that empty into them, time will effect this purpose much sooner than some would suppose; especially if the water furrows, when the field is cultivated, be constructed, so far as it may be found practicable, to run into them. The water furrows should also be formed to empty into the quarries when it can be done. This, together with making them the common receptacle for every useless rubbish, (which must be removed to some place,) will, in time, fill them up. While these slow, but certain processes are in operation, they will set an excellent example to the farmers in the neighbourhood; who but too generally, for the want of a little labour and attention, suffer these very unseemly nuisances to perpetuate their neglect.

For the preposterous and very injurious practice of leveling the heights and hollows in fields, we are indebted to England. There proper machines have been constructed to execute this ruinous business with despatch. With these, the soil is removed from the heights and emptied into the hollows; which are already enriched by the washings from the heights. By this inconsiderate practice, the soil is doubled in the hollows; and the heights, unless the soil be deep, are reduced to sterility. It would be an excellent practice to spread more manure on the heights, and leave the leveling of the field to cultivation and time, which will certainly effect it. He must be a bad farmer, who cannot water furrow his grounds so as to keep the hollows sufficiently dry.

Where land is cheap and population thin, boggy and springy places should be sown in herdgrass and remain in it, even if it should spoil the looks of a field, or of every field on the farm. Profit ought to be the farmer's aim: therefore, it matters not how his fields look, if at the end of the year, the balance of his profit and loss account book looks well: particularly, as he has no cause to complain of the boggy or springy places, as they have furnished him with good hay, and no longer mire his cattle when pastured in the fields. Where land is high and labour plenty, the gentleman may sow such places with the same grass, and let them remain in it until he is well informed in the art of draining. Although we have some excellent writings on that subject in this country, it is far from being practically understood. As it is very difficult to cut off the springs judiciously without practical experience, a great deal of money may be readily spent in draining, to but very little purpose; particularly in under draining. Where the excess of moisture does not proceed from springs, this expense may be avoid-

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ed, and the superfluous moisture more effectually run off, by a proper system of cultivation alone.

When stumps are fast in the ground, removing them by grubbing, is very expensive, and should never be done. The screw invented in England for blowing them to pieces with gunpowder, may answer in that country where labour is cheap, and the wood may be advantageously used for fuel: provided the stump be sound; for when it is otherwise, or cracked by the falling of the tree, or in any other way, the blast is commonly ineffectual. Stumps have been removed in the eastern States, with great facility, by what is called here the Yankee lever. It is represented to be a simple piece of timber with canthooks so fixed in the middle of it as to grasp the stump, a powerful yoke of oxen is attached to each end of the lever, and these, by moving in contrary directions, it is said, and in a way that seems to leave no cause for doubt, quickly extracts the stump.* However, I advise the gentleman not to attempt even this mode of extracting stumps, unless he can procure workmen who are practically acquainted with the business, and cattle that are calculated to effect the purpose. When the roots have become sufficiently decayed for a pair of oxen to draw out the stump, by a log chain hitched around the upper part of it, a great many may be taken up in the course of one day, and with but very little expense.

Blowing rocks which stand above the surface of the soil, is very expensive; especially if they do not split freely. Filling the holes with the earth around them, injures the soil, and if earth and soil be hauled for this purpose, which seems to be the best way, it is expensive. Although the plain practical farmers are in the practice, it is a doubtful one, for none but the wealthy encounter it, and the principal part of the labour is done at leisure times, by themselves and family: consequently, they neither feel nor estimate the expense: I therefore, advise the gentleman not to engage in it until he can accurately calculate the expense and compare it with the improvement. If this be done, it seems probable that he will not encounter this business until he becomes well acquainted with it, and can hire a blaster whom he knows to be expert; otherwise much time and powder may be expended to but little purpose. He should also have some valuable use for the stone, or sell it to some person who will haul it off the field, for even this alone is expensive. Surface stones must be removed, or the grounds cannot be mowed. Concealed stones near the surface of the soil, occasion tedious and bad ploughing, soon dull the irons, and sometimes break the plough: still the gentleman had better not commence the removal of them until he has been a year or two on the farm, for it requires well formed plans to effect even this without considerable useless expense. The larger stones got in this way, and gathered from the

* When the stump is large and very fast in the ground, two pair of powerful oxen hitched to each end of the lever, do not seem to be too many, if enough, provided the roots be sound.

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surface, may be either sold or reserved for building, and the smaller ones applied to stop the washings which run into the gullies, or mend the roads, or may be reserved for under draining, or hauled into the quarries.

When a fence is run between the woods and the fields, the practice of cutting off the communication of the roots of the trees, with the cleared grounds, is attended with but little extra expense where timber is valuable. The bank and ditch save two rails in each pannel, also something in the length of the post, and the roots of the trees exhaust the field and injure the crops. But after some time, the roots grow downward a little within the surface of the soil, and cross the bottom of it, and mounting upward, find their way into the field without being seen. However, by cutting them off occasionally on each side of the bottom of the ditch, they may be prevented from doing any very serious injury to the field. In doing this, care should be taken not to make the ditch any deeper than it was at first. It has been observed that the roots of trees cross very deep gullies in the same way as they cross the ditches: therefore, no good, but much evil will arise from making the ditches deeper, every time it becomes necessary to cut off the roots in the bottom of them.

The late plentiful introduction of merino sheep, will terminate as a very great advantage to this country; provided this animal be not despised and neglected, because its valuable properties fall so very far short of realizing the golden dreams of infatuated speculators. Their compact form and close pile of wool, or some other cause or causes render them, or even a mixed breed with them and the common sheep of the country, much hardier than the latter. They will thrive on the same food and usage that common sheep fall away on; are more readily fattened, and much less subject to disease. Their wool also sells at a much higher price. Still, common sense dictates, that the price of them must ultimately terminate in the value of the materials of which they are composed. This might have been as clearly seen before the ill judged speculation in these animals took place, as at the present or any future time. Yet if they had actually possessed the golden fleece *prefigured* to us on signposts, or some other properties equally productive, more could have scarcely been said of their value; or more industriously propagated in almost every possible way, by interested speculators; or by gentlemen whose imaginations were as highly inflamed by the enthusiastic dreams of profit, as was those who ran crazy when the mania for the bank-scrip prevailed. Formerly, large animals were the object of speculation. Now, form, bone and a disposition to fatten freely, take the lead. The latter seems to have reason on its side; and it may be readily effected by judicious mixtures of the various forms and properties so very conspicuous in different animals of the same kind; and no question but the value of every kind may be greatly enhanced in this way. It is, however, doubtful whether the ingenuity of the cattle jockies will permit this improve-

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ment to remain permanent. They are like barbers, milliners and many others, whose profit principally depends on the alteration of fashion, and where customers but too generally find every possible convenience attached to the latest.

The cattle jockey when the market is full of the best and most approved breeds, will be compelled to receive a moderate profit, or like the keen sportsman start fresh game. The latter accords much better with the exorbitant profit attached to his business; therefore new game will be started, and if we may judge from the past of what is yet to come, it is to be feared that by far too many gentlemen farmers will follow the chase, with as much avidity as the gay world follow the fashion of the day. It should, however, be recollected that a gentleman farmer does not possess the qualifications of a cattle jockey. If he were well acquainted with these qualifications, it is presumed he would despise them too much to put them in practice; consequently stocking his farm with domesticated animals at exorbitant prices would be ruinous to him. The real value of these animals is no further increased, than the extra profit arising from the different improvements that had been actually made in them, which will be finally determined at the butcher's market, &c. This will be found scarcely worthy of consideration, when contrasted with the immense prices at which they are sold, while they continue the objects of an infatuated speculation: still if the gentleman be rich, he may promote the interest of agriculture by a moderate introduction of improved animals, without any serious injury to himself.

It is certain that the rage for gentleman farming in England, has introduced many valuable improvements, but it is equally certain, that the immense wealth possessed by some of those gentlemen, together with a general emulation to excel, have induced many of them to introduce expensive practices, which are better calculated to ruin farmers, whose income depended on the proper management of their farms, than to promote their interest.

Bookmaking is a trade well understood in England. The opulent are the best customers, and the patronage of some of them is highly important. To secure these advantages they must be pleased. This is difficult unless their bad as well as good practices be equally recommended. Another source of extensive error is opened, when wealth, talents, or zeal improperly directed, happens to obtain too much influence in agricultural societies, as the act of publication stamps intrinsic value on error; for the reader is naturally induced to believe, that the subject, after being duly investigated, has obtained the approbation of the society, or it would not have been published by it.

There is no practice so bad but it may, and too often is, advocated, even by men of talents. Horseracing has been long, and too successfully patronised by those who are fond of the sport. They urge that the practice promotes emulation, and that this is the best means that can be devised to insure the improvement of that noble

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and very useful animal. However, the collected wisdom of our State, has justly considered this practice very injurious, and has endeavoured to suppress it by heavy fines and penalties.

The same arguments are used in favour of plough races, cattle shows, and sheep shearings. They are published with the same eclat that horseraces commonly are, and pretty much in the same style.

The pedigree of the animal is traced back so far as they can obtain any credit from their ancestry. After this, as is the practice in prudent families, genealogy ceases. It should be recollected, however, that the evils arising from these practices, are equally, if not more injurious than horseracing. The emulation to excel, induces many to pay for a single animal, more money than would purchase all the live stock necessary for a valuable farm. If this practice were confined to gentlemen possessing immense estates, the evil, although the example is very injurious to the economy of farming, would not be so great, but gentlemen of very limited fortunes too often possess equal ambition of this sort with the great, and are frequently ruined, or sadly injured, by these inconsiderate practices; while the plain practical farmers, although some of them possess more wealth, wisely avoid these ruinous speculations, unless they commence the business of a cattle jockey, which too many of them have done, especially in England, for the express purpose of enriching themselves and families, by preying on the ignorance and folly of gentlemen farmers. Although this class of people are considered stupid and ignorant, by too many of the learned writers on husbandry, they have proved the contrary, as the exercise of their talents and wit in this disgraceful business has enabled some of them to accumulate considerable estates.

This puts me in mind of once enquiring of the keeper of a toll gate, whether he knew of any store cattle for sale in his neighbourhood. He said he did not, but pointing to a farmer standing by, observed that this man dealt in cattle. The stranger said he was very sorry that he had none at this time for sale, as he always preferred dealing with gentleman farmers. This was accompanied with a smile so expressive of what he thought, that it appeared useless to inquire the cause of this marked preference.

Gentlemen who are fond of associating with, or entertaining large mixed companies, might readily do this without connecting the folly or expense with the economy of farming; this, instead of promoting agriculture, is exactly calculated to prejudice the minds of those against it, whose pleasure consists in a circumscribed circle of friends.

It will be very natural for them to conclude, that the whole amount of wool commonly obtained at a sheep shearing would not defray the expense of the entertainment, which, without the addition of this serious evil, would be disagreeable to them, as they must necessarily entertain numbers with whom they would not wish to associate.

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The admirers of agriculture should not injure its simple but lovely and necessary economy, by connecting useless, injurious, and expensive practices with it. I therefore advise those who cannot be happy, unless they spend a portion of their time and money in sportive gratifications, to resume their racehorses, hunters, grooms, huntsmen and hounds. In this case the injury done by breaking fences, trampling grain fields, &c. will be of but trivial import when compared with the expensive agricultural practices introduced by them; this is not all, their pleasure will be greatly promoted by the change, for the beautiful figure of an Arabian or a hunter infinitely surpasses that of the most highly improved bull, ox, or sheep; and the bleating of sheep, lowing of cows, bellowing of bulls, or grunting of hogs is still further surpassed, by the infatuating harmony of the huntsman's horn, and a good pack of dogs in full cry.

The race between lubberly plough horses or sluggish oxen, especially when hitched to a plough, bears so little resemblance to that between animals well calculated for and trained to this exercise, that it seems to be useless to contrast them. The former is better calculated to exercise the patience, than to promote the pleasure of the spectators; and this the plain practical farmer knows full well, especially when unfavourable weather, or any other cause, induces him to hurry in his seed.

Reading is highly important to the gentleman farmer, for it must be a worthless book indeed, from which nothing important can be gathered. It should, however, be recollected, that it requires practical information to enable him to separate the chaff from the wheat. This is best obtained by observing the practice of plain practical farmers, and conversing freely with them. Although their too general prejudice against books on agriculture has greatly retarded their progress in improvement, many of them possess strong minds, and have acquired much information from practice, united with attentive observation.

It is also evident that the same may be said of farmers in general as of books. He must be a bad one indeed from whom no useful information can be obtained. It sometimes happens that even the short cuts which slovens take to avoid labour, introduce the best practice that can be pursued; the gentleman, however, should always keep in view, that his intercourse with plain practical farmers is to gain, and not to give information. If this be done, he will find them obliging and ready to communicate; but if, like too many, he forgets his errand, and talks of what he has done or intends to do, or should he presume to recommend his own practices to them, they will soon see that the gentleman has either overlooked the business he designed to accomplish, or suspect that he came for the express purpose of instructing them. The latter will be considered useless, for they have too often witnessed the blunders of gentlemen farmers to be instructed by them. If the gentleman's management be rational and judicious, the silent display of his crops will eventually gain the respect and esteem so justly due to unassuming

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merit, and the plain practical farmer will the more cheerfully adopt his better practice; and if death or any other cause should remove him from the neighbourhood, his absence will be regretted, and his memory respected. His labourers will respect his talents and prudence, and cheerfully submit to be directed by him. For even this class of men are not so stupid or obstinate as too many have represented them to be; their pointed observations and shrewd remarks on the blunders of gentlemen farmers, clearly determine that they are not deficient in native talents. It is, however, to be lamented, that these blunders too often excite inveterate prejudice, which induces them to be opposed even to good practices that they do not happen to understand. Yet it should be recollected that the learned are not always exempt from this evil, or the obstinate pride which induces too many to persist in error long after their judgment ought to have been convinced.

A description of an immense number of agricultural tools and implements, with engravings of them; together with explanations of their important usefulness, and the proper way of forming and using them, form too great a portion of too many books on agriculture. This may be useful to printers, bookbinders, and engravers, but is exactly calculated to injure gentlemen farmers, who are not yet taught to discriminate, especially as many of these tools and implements are complicated, expensive and difficult to be used by those who are not intimately acquainted with them; and by far the greater part of them are useless, or much surpassed by the cheap and simple instruments and implements in general use. This is not all, for many of them have been found very expensive and injurious to the interest of those that have tried them; although the recommendation of them has been backed by flattering calculation, and pompous promises of the immense sums of money which might be saved by the introduction of them. It is true those calculations have been formed on erroneous principles, but it is also true that a gentleman farmer in the commencement of his business cannot readily detect the error. In fact, too many of those books are better calculated to lead him into error than do him any good, especially as it may be justly considered as a maxim in farming, that in general the most simple and cheap instruments and implements are by far the best. However, the gentleman too frequently thinks otherwise; hence it is that if you happen to visit a gentleman's farm which has been some years in operation, you will but too frequently see as many useless implements and utensils lying about in every direction, as would induce a poor man to consider himself rich, if he only possessed half the money which they had cost the owner.

Having finished my remarks on the gentleman's extensive, and very expensive preparations for the accommodation of his family, and also for farming, I will in the next chapter examine his management and practice in husbandry.

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CHAPTER XLIV.

The delusive expectation of rural enjoyments considered. Observations on the erroneous calculations of profit arising from sending fruit, vegetables, &c. to market. The value of maize contrasted with that of potatoes and other roots. The means by which the gentleman may soonest and best become acquainted with practical husbandry.

Although the gentleman seldom intends to remove to the farm until his buildings are so far finished as to afford a comfortable residence for his family, it often happens, that a desire to counteract the wanton waste and idleness going on there, or an impatience to commence the enjoyment of a rural life, induces him to remove sooner.

It is true, the house which had been too hastily condemned, would have accommodated his family infinitely better. It, however, happens in this case as it does in most other cases,

"Man never *is* but always to be blest."

The gentleman believes that after his buildings are completed all the calm, consoling enjoyments of rural felicity will ensue. Yet he might have been better informed, for he must have known that thousands who had tried those fancied enjoyments from their cradles were continually leaving the country, and flocking into our cities and towns, with as much avidity as if happiness were no where else to be found.

This phantom eludes the grasp of all those who do not wisely enjoy the present moment as it flows along, without regretting the past, or brooding over what is yet to come. However, it so happens, that the gentleman thinks otherwise; and he cheerfully submits, for at least twelve months yet to come, to subject himself and family to the trifling inconvenience of being barricaded with vast quantities of materials necessary for finishing the buildings. These being heaped up around the castle render the entrance to it inaccessible, except by confined roads, which are all but impassable, having been completely cut up and filled with slough by the incessant intercourse of heavy laden teams. To this we may add the perpetual din and clatter of axes, saws, files, planes, hammers, and noisy workmen; together with the suffocating dust arising from the lime, or the sweeping out of the unfinished rooms in which the mechanics are working; also, inhaling the very disagreeable and unhealthy effluvia from newly painted rooms, glue pots, &c.; together with being kept in perpetual alarm for the safety of the children; they are sometimes found bemired in the sloughs or beds of mortar; or at other times they are seen playing under the scaffolds on

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which the men are at work, or round the unfinished doorways that lead into the cellars, or caught heedlessly walking on a single joist or board, with destruction yawning beneath them. One year, however, of perpetual vexation may be considered but of little moment in the life of man when he has future happiness in view. We read that Jacob, although he was baffled and sadly cheated, cheerfully served fourteen years for Rachel. Yet, if he may be believed, he had not been happy, for he tells Pharaoh that "few and evil have the days of the years of my life been." It is true, that notwithstanding this high authority, a very considerable allowance should be made for old men after they are no longer capable of participating freely in many of the rational pleasures which, in their full extent seem to be the exclusive privilege of youth and maturity, are very apt greatly to underrate the sum total of human felicity.

Before I proceed further, it may be proper to inform the reader that in attempting to describe gentleman farming, it is not to be expected that all the injurious practices which ought to be exposed are adopted by each one of them: on the contrary, their views and practices are as different as the opinions of the different authors they may happen to read; and, although I have not seen it, some of them may have proceeded in their business judiciously and profitably from the commencement of it. Neither is it to be expected that my observation aad memory can embrace the whole of the various causes which operate against gentleman farming. However, I hope enough will be advanced on this very interesting subject to enable the gentleman to proceed safely and profitably in his agricultural pursuits; also, to convince the impartial reader, that if gentlemen do not succeed in agriculture, it is because they do not practice the strict economy and personal attention which, from the nature of their business and the independent situation of the labouring part of the community in Pennsylvania, are actually necessary: this independence is justly the pride and boast of every State in the Union where slavery is abolished: especially as an increased population will in a great measure remove the partial evil arising from it; still it must be confessed that at present it makes greatly against gentleman farming. As the demand for labour is such, that, if the farmer knows the person who offers to hire has behaved badly in the employment of his neighbour, the suffering situation of his crops, or some other pressing cause, seems to compel him to employ the man, although he has little but trouble and perplexity to expect, and perhaps abusive language into the bargain.

Gentlemen too often make large calculations of the money that may be made by sending vegetables, fruit, butter, cheese, &c. to market. They have observed these things command high prices: especially when they consist of an early supply of such articles as the seasons with good management produce. Also, that many living in the vicinity of cities had from small beginnings amassed considerable estates in this way. This too often induces gentle-

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men to make very expensive preparations for maketing. They considerably increase the size of their gardens, hotbeds, &c.; also, milk house, ice house, &c.: likewise, plant an immense number of fruit trees, bushes, &c. that nothing may be wanting which is likely to insure success.

But, unfortunately, he does not consider that the people who got rich in this way go with these articles to market themselves. They are acquainted with the business, and if any thing is left after the usual hour for sale, they know the huckster it will suit, and how to obtain the best price for it. So soon as the farmer's market is finished he returns home to his business without any delay. During his absence his wife and his children are busily employed, some in the gardens and others in the field; and their presence and example keep his labourers at work while he is from home: such management as this will make a man thrive in any business that is worth following.

The gentleman is very differently situated: he neither obtains nor wishes the menial assistance of his family. Neither will he, nor should he, go to market himself: consequently every thing is hired, even to the gathering of the fruit, potherbs, &c. and tying the latter up in bunches fit for sale: therefore, the whole of it, from first to last, is exactly calculated to promote idleness, chicanery and fraud. However, it appears that the gentlemen knows nothing of this; and so soon as the fruit trees, bushes, &c. found on the place, together with his gardens and fields, afford a sufficient variety to make a beginning, his golden project is commenced. A well turned pair of horses, with a light covered waggon and a neat set of harness is purchased. He hires a man who he is told is well calculated to drive the waggon, and sell what may be sent by him to market. Being now, as he believes, completely fixed, a well assorted load is ordered, and that the man should start early the ensuing morning. This finds employment for the market-man and several other labourers the whole of the afternoon; for after the vegetables, fruit, &c. have been gathered, they must be properly fixed for sale, and the people take care not to hurry themselves in this tedious employment. In fact the gathering and fixing alone, too often costs the gentleman more money than he receives for the whole load. As he has not been accustomed to rise early, and removed to the country for the express purpose of enjoying ease and repose, he depends on his head man or farmer, and the latter too generally suffers the sun to shine for some time through the windows on his bed, before himself or any other person on the farm, thinks of rising: consequently by the time the gentleman's market-man has got cleverly fixed in market, the industrious common farmer, who had started from home long before day, is gearing up to return. Of course, the gentleman's load, although it may be well assorted, hangs heavy on hand. This is soon observed by some keen huckster, who, at a proper time, makes a bid for the whole. As it is now too late, and no purchaser had for a long time

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appeared, and nothing better is likely to offer, the bargain is closed, and the market-man starts for the farm. The gentleman is astonished when he sums up the scanty returns; but the market-man gives several ingenious reasons why it so happened, taking care to keep the real cause out of sight; and, as he rises earlier the ensuing trip, his returns are better, though very far below his employer's expectations. Thus the business generally goes on, sometimes better and sometimes worse. But, unfortunately, especially for gentleman farmers, the roads near our large towns are crowded with grog or dram shops. Still, although the gentleman's market-man may be sorely tempted by Satan, or his own propensities, he neither likes to disgrace the recommendation he has so recently obtained, nor to lose a very easy birth. He, therefore, commonly resolutely passes by the whole of these, for some few days at least. However, habit, joined with the importunity of his old potcompanions, too soon shake his resolution.

In this case, the horses are generally left standing at the door. As the driver commonly becomes forgetful of them, hunger may at length induce them to move off; and it may happen to the gentleman as it once did to myself. However, happen what may, nothing good is to be expected when his market-man gets drunk.

My light waggon, loaded with potatoes, started in the morning before it was light, as the driver had six miles to go before he reached the market. It had frequently happened that those sent before did not return back until some time after it was dark; although the industrious farmers in my neighbourhoood, who drove their own teams to the same market, commonly returned about the middle of the day. The man now sent, did not return until twelve o'clock in the night, and then informed me he had stopped at a *friend's house* on the road, and that the horses had run off with the waggon, and he could neither find nor hear any thing of it. All the men on the farm, were immediately mounted and sent off in different directions, but the team was not found till the fore part of the ensuing day. They had taken a road which slanted off from the farm, and hitched one of the wheels fast to a tree growing on one side of it. As they remained quietly in this situation, no damage but the loss of one spoke occurred. However, as the horses were valuable, and the waggon had been little used, a serious loss was expected by me.

This, with many other perplexing circumstances, actually compelled me to abandon the practice of growing the potatoes as a mixed crop with maize, although they were by far more profitable for this purpose, than any other plant known to me, if any rational mode of selling them could have been devised. But I must either let them rot on my hands, or be subjected to perpetual inquietude, and insupportable impositions, by sending them to market. The man who lost my waggon and horses, was five years in my employment, and the best workman I have ever had. He was too fond of spiritous liquors; still, he seldom drank to excess on the farm, and was active, ingenuous and very obliging. Many others, however,

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were tried both before and after this accident, and I can truly say that I never met with one, that was even tolerably well qualified for a market-man. Some were too ignorant; others were idle and negligent; many would get drunk, and from the scanty return which but too frequently happened, there was reason to suspect that many of them were far from being honest.

The gentleman farmer should studiously avoid every practice that would compel him to depend on the talents, sobriety, honesty or industry of his people when sent off the farm: consequently, his crops should consist of such articles as could be either profitably consumed on it, or sold at once by himself to the merchant or miller. The latter often keeps teams, and will commonly contract for delivery at the farm. When the merchant is the purchaser, the gentleman may generally get some honest waggoner in his neighbourhood to haul the article, and bring receipts back for each load. Butchers, in plenty, will call to purchase and drive off the live stock he may fatten for sale.

His hay and straw ought to be consumed on the farm, which will save him the endless perplexity of sending these articles to market, and hauling back dung in return. By this mode of management, fewer horses and working cattle will suffice, and being under his own eye, they will be much less subjected to abuse and injury. His waggons and carts may be lighter constructed, the better to suit the business of the farm.

One horse carts are now fashionable on a farm; but after the rage for novelty has subsided, it will be found that a judicious mixture of carts drawn by two horses, and waggons, will be far better: especially in this country, where the wages for drivers come high, for although one man may drive several carts on plain or turnpike roads, this cannot be advantageously done on a farm.*

The products of agriculture have been greatly increased in Great Britain, by attention to grass, roots, &c. and also to manuring and cultivating the soil. But too many in this country have mistaken the cause of this improvement, and attributed it to the advantages derived from preparing an abundance of juicy food for their cattle and sheep, by an extensive growth of the roots used for this purpose. This has induced some of our best writers on agriculture, highly to recommend an extensive growth of these roots; and also to cook them for the cattle. They have enforced this advice by elaborate calculation, of the immense advantages to be derived from this practice. This has induced too many gentlemen farmers to adopt the plan in the commencement of their business.

The labourers in this country have been accustomed to cultivate

* I have never tried the practice, but am very much disposed to believe, that the expense of waggons may be saved on a farm of a moderate size, and the work more expeditiously done by carts drawn by two horses: provided the ladders for hauling the hay and grain be so fixed as to carry as much of either, as the horses can draw, without danger of the cart being readily overset by the height of the load.

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potatoes, therefore, the gentleman finds no difficulty in obtaining considerable quantities of them. As most of our workmen have assisted in cultivating cabbage, in gardens, they will the more readily submit to the tedious employment of setting them out in fields, and the gentleman's gardener may cultivate the plants. But, notwithstanding our labourers have been accustomed to sow and gather turnips on a very contracted scale, they know nothing of hoeing them, and too generally consider it useless, therefore seldom attempt to improve. As turnips are commonly gathered when the leaves are frozen or covered with frost, there is no business done on a farm, that requires more patience and fortitude than pulling and topping them. It, therefore, seems almost impossible to get an extensive growth of them properly secured. If they be pulled early, and the weather continues warm, fermentation destroys them. Added to this, the depredations of the fly render them the most precarious crop that is grown by us.

The cultivation of carrots is still more opposed by the labourers in this country. They come up very spindling, and are not readily distinguished from the weeds, while the plants are young, unless the labourer assumes a kneeling, or a squatting posture. However, the gentleman knows nothing of these difficulties, and it seems reasonable to believe, that if men be well paid for their labour, no difficulty ought to arise from putting them a little out of their usual way: especially, as it will increase their knowledge, and the gentleman wishes to improve the agriculture of the country. It is, however, a well known fact, that even in countries where an increased population and other causes seem to compel the labourer to be more subservient to the will of his employer, it is often found difficult to introduce new practices in husbandry, in consequence of the opposition made by those employed in the execution of the work. As the labourers in this country are very independent, the gentleman too generally finds his workmen quite as much, or perhaps more, disposed to wage war against the turnips and carrots, than against the weeds infesting them: particularly, as they believe, it is his ignorance of farming that induces him to impose this supposed useless, and at the same time, very disagreeable business on them.

Here it may be asked, are we to permit the inconsiderate prejudices of labourers to exclude improvement? Certainly not, but can it be prudent for a gentleman who does not know how to instruct them, to introduce practices entirely opposed to the habits of his workmen; especially, on an extensive scale: when, if he was intimately acquainted with the business, and capable of teaching them, and they were willing to be instructed, he would find, that one man who understood hoeing and setting out turnips and carrots, at proper distances apart, would not only do the work infinitely better, but also get through, in the same space of time, as much of it as two or three men who had no practical knowledge of the business. This difference in the expense of cultivation alone, is certainly sufficient to prevent the profitable cultivation of those

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roots; as well as of the parsnip and beet, except on a very limited scale, to be regularly extended, provided they should be found as profitable as they have been represented to be.

My cultivation of the turnip has ever been a limited one, and they have always been hoed. This has never failed to be a very tedious, and of course, an expensive job. When finished in the best way that I could get it done, many plants were left standing that ought to have been removed, and numbers cut off which should have been suffered to remain. Notwithstanding, I have never had quite two acres of this root cultivated at any one time, and commonly sow earlier than my neighbours, (as I do not believe, as too many do, that frost makes this or any other plant, grow better,) I have ever found it difficult to get them pulled, topped and properly secured in due time. Once an unexpected hard frost made it necessary to dig up a considerable proportion of them, with the hoe, and to form shelters to keep off the piercing notherly winds from those employed in topping them.

Use and observation alone, seem to determine that the potatoe is the most nutritive root known to us. This is confirmed by the chemical experiments made and quoted by Sir H. Davy; he says, "the potato is the bulb that contains the largest quantity of soluble matter in its cells and vessels; and it is of most importance in its application as food."* Use and observation, seem clearly to determine, that the common turnip is not one-half so nutritive as the potato, and Sir H. D.'s experiments rate them much lower than this; for although he estimates the nutritive matter in the Swedish turnip, about fifty per cent. higher than in the common turnip, the former does not appear from his statements, to possess but little more than one-quarter as much nutritive matter as the potato. The nutritive matter contained in the carrot and parsnip, he rates at less than one-half, and that in the beet, at about two-thirds as much as is found in the potato; and the cabbage contains something more than one-quarter as much nutritive matter as the potato.†

This gentleman remarks, that "it is probable that the excellence of the different articles as food, will be found to be, in a great measure, proportional to the qualities of the soluble or nutritive matters they afford; but still, these qualities cannot be regarded as absolutely denoting their value. Albuminous or glutinous matters have the characters of animal substances; sugar is more nourishing, and extract matter less nourishing. Certain combinations likewise of these substances, may be more nutritive than others."‡

This is certainly a very interesting subject. It therefore ought to be diligently investigated in every possible way. We should not be discouraged, although we have yet much to learn. The marked

* See his Lec. on Agr. Chem. page 139. † Idem, page 150.
‡ Idem, from page 138 to page 152.

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difference in the excrementitious matter from different animals which have been fed on the same provision, determines that their food has been very differently elaborated; consequently it is reasonable to suppose that the different nutritive matters contained in the food are more profitably applied by some, than they are by other animals. This fact seems to be established by practice. As the ox ruminates, he obtains a better support from dry straw than the horse. The dung of an ox shows, that the woody fibre of the straw has been finely divided by him. It also seems as if less of this fibre remained, than is found in the dung of the horse. But as there are many animals who neither ruminate, or even masticate their food, who possess the power of digesting very hard substances, there can be but little doubt that some of the nutritive matters contained in the food commonly given to domesticated animals, is far more andvatageously elaborated by some of them than it is by others, whether they may or may not ruminate. Still, on the whole, there is every reason to believe with Sir H. Davy, that "the potato is the bulb that contains the largest quantity of soluble matter in its cells and vessels, and that it is of most importance in its application as food."

This being the case, the gentleman will act wisely, if he confines his cultivation of roots principally to the potato. On the whole, he will find it most profitable, and his workmen are acquainted with it.* But this plant, if the product be consumed on the farm, is greately inferior to maize. Yet Mr. Bordley, in his book on Agriculture, promises to the nation a saving of 1,600,000 dollars yearly, and also the use of 1,412,000 acres of land, which might be applied to some other use, if hogs were fattened on potatoes, with a dusting, (as he terms it,) of Indian meal.

He says it would require seventeen bushels of potatoes, and seven-tenths of a bushel of Indian meal, to fatten a hog weighing one hundred and sixty pounds, and that seven and a half bushels of corn would do the same. He allows ten acres of ground to grow seventeen hundred bushels of potatoes, and four and seven-eighths acres to grow the corn to dust them. The produce arising from those fourteen and seven-eighths acres, he considers sufficient to fatten one hundred hogs of a hundred and sixty pounds each; and that it would require fifty acres of ground to grow seven hundred and fifty bushels of corn, which he allows would be enough to fatten the same number and weight of hogs.

He estimates the cultivation of the maize at five dollars per acre. This may not be far underrated, as the produce is only fifteen bushels to the acre; for a soil capable of producing no more corn than this, would not be likely to trouble the cultivator with a multiplicity of weeds; and the expense of gathering so light a crop, must be inconsiderable. He rates the whole expense of cultivating the potatoes, which observe, he says, should be manured at thirty-

* No crop is more certain than potatoes; other roots are precarious; so are cabbages. The seasons for planting them are often very unfavourable.

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six dollars and sixty cents. This sum would not cover near the expense of manuring, and cultivating one acre alone. It would not pay for hauling and spreading the manure, if the distance from the cattle yard to the field, was only moderate. If Mr. Bordley's estimate of the value of dung made on a farm, be admitted, it would not pay for a sufficiency to manure one acre and a half, without charging any thing for hauling and spreading it.

If the manure were purchased and hauled from some town near the farm, it would not pay for manuring one acre alone. It would not purchase half the seed, unless potatoes were a drug, and would fall greatly short of paying for ploughing, harrowing, cutting and planting the seed, and keeping the crop free from weeds. With very good management, this trivial sum might pay half the expense of ploughing out, gathering, and securing the crop. Such random calculations are only fitted to mislead the gentleman farmer in the commencement of his business. If seventeen hundred bushels of potatoes were to be realized for thirty-six dollars and sixty cents, they would cost the farmer but a fraction more than two cents per bushel, and the rent of the soil. Although the gentleman knows nothing of farming, his previous habits have taught him the value of calculation. Therefore it is not to be wondered at, if he should determine to grow large quantities of potatoes, and erect the steaming kettles, tubs, and washing machine recommended by Mr. Bordley; also buy many hogs, and sink a large sum of money before he is better informed.

But to return. When the valuations of crops are compared, they should be placed on equal footing. If this had been done, ten acres manured as is commonly done by good thrifty farmers for a potato crop, would have been found fully sufficient to grow seven hundred and fifty bushels of corn. This simple, but obviously just method of estimating the comparative value of crops, clearly demonstrates a very considerable balance in favour of maize, when the estimate is made in the way or mode pursued by Mr. Bordley. Even admitting that seventeen bushels of potatoes dusted with seven-tenths of a bushel of Indian meal, is equally as nutritive as seven and a half bushels of corn, than which nothing can be more erroneous. Although it will not require more than one acre of ground, if it be manured, to grow the corn for the dusting meal, still that acre will furnish seventy-five bushels, which agreeably to Mr. Bordley's estimate will fatten ten hogs. The fodder from ten acres of corn that produces seventy-five bushels to the acre, if estimated no higher than was obtained from maize grown by me which produced only sixty-six bushels of shelled corn per acre, would be full thirteen tons; this at the reduced price of eight dollars per ton, amounts to one hundred and four dollars, which sum agreeably to Mr. Bordley's estimate of the corn at fifty cents per bushel, would purchase a sufficiency to fatten twenty-seven hogs.

Yet this gentleman makes no estimate of that grown on the fifty acres of maize introduced by him, although he must be well ac-

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quainted with the great value of it, as himself, and the rest of my countrymen and neighbours on the eastern shore of Maryland, found the leaves, or the blades as we called them, of this plant, excellent fodder for our horses, and the husks and tops quite as good for our cows, and other horned cattle. But notwithstanding the immense numbers of impoverished and starved acres of corn grown in that country, too much straw is allotted to the half famished cattle there, as well as by too many inconsiderate farmers in Pennsylvania. But to proceed; the average price of potatoes, taking one year with another, seems to be about fifty cents per bushel. It requires about twenty-five bushels of full sized marketable potatoes to plant one acre properly. It is true, small, or what are commonly called planting potatoes, are generally used, and as these will not sell for culinary purposes, they may be generally bought at half, or less than half price, but as the cultivator loses much more than he gains by planting inferior seed, that article should be rated at not less than thirty-seven and a half cents per bushel, or nine dollars thirty-seven and a half cents per acre; from this deduct seventy-five cents for seed corn per acre; this leaves eight dollars, sixty-two and a half cents, which on ten acres amount to eighty-six dollars, twenty-five cents, and agreeably to Mr. Bordley's calculation is equal to fattening twenty-three hogs.

The expense of a manured crop of corn, if it be not less, cannot well be more, than the expense of a potato crop. The manure, rent, and preparation of the soil of both crops may be considered equal. The cutting and planting of the seed, with the cultivation after planting the potato crop, when united, will cost full as much, if not more, than planting and cultivating the maize. The latter may be husked and cribbed for the same money as will take a potato crop out of the ground, and secure it properly. It is true, the saving of the corn fodder in the most economical way will cost from two dollars to two dollars and a half per acre, but this has been rated at a low price, particularly as some farmers, whose cattle have been accustomed to it, prefer it to hay, even for their milch cows, and no estimate has been made of the value of the stalks for litter, and they are fully equal to the expense of gathering the fodder, as they weigh rather more than it, whereas the litter obtained from the potato vine, if the crop is not gathered until it be fully ripe, is of but little comparative value.

Thus, agreeably to Mr. Bordley's own estimates, (except the value of the seed for planting the potato crop, which he certainly rates far too low,) a crop of maize, if that plant be fairly treated, is sixty per cent. better than a crop of potatoes, even if seventeen bushels of the latter when steamed, and dusted with seven-tenths of a bushel of Indian meal, were equal to seven and a half bushels of corn. It should be remembered that, although steaming the potatoes brings much more of the nutriment contained in them into effectual use, that soaking or boiling the corn produces the same useful effect, with much less labour and expense.

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No question but the reader will agree with me that hogs fattened on potatoes are vastly inferior to those fattened on maize; also, that the necessary conveniences for washing and steaming the potatoes, together with the labour and fuel, will cost a great deal of money, for the article is bulky, and must be first removed to the washing machine, and from thence into the steaming kettle, and after this again removed and carried to the cattle; yet these very serious expences form no part of Mr. Bordley's estimate.*

However, the foregoing observations on this gentleman's calculations have been made, merely to show, that if Indian corn be treated fairly, it is a much more profitable crop for feeding hogs, and consequently other domesticated animals, than potatoes. Even when the essential parts of this gentleman's estimates are admitted. But as his calculations are erroneous throughout, and I do not wish to mislead, it is proper to observe, that Mr. Bordley has estimated the product of an acre of potatoes quite too low. For the thrifty practical farmer commonly applies as much manure for a potato crop, as ought to grow about two hundred and forty bushels of this root to the acre; and from such a manuring he ought as fully to expect seventy-five bushels of shelled corn to the acre. Agreeably to this estimate he obtains three bushels and a quarter of potatoes for one bushel of corn, and in or about the same ratio, if he manures for both these plants, much higher than is commonly done for a potato crop.

Now, it has so happened, that my respect for Mr. Bordley's very superior talents, induced me to try his plan of steaming potatoes; and I have also boiled and fed them raw to hogs, horses, fattening cattle and milch cows. The result has been, that I would greatly prefer one bushel of maize for any one of these purposes, to four bushels of potatoes; and in this instance, practice and observation seem to accord with chemical experiment: for Sir H. Davy says, "that one-fourth part of the weight of the potato at least may be considered nutritive." But it should be recollected that this nutriment is not, on the whole, in its nature and properties, equal to that in corn, and that the weight of a bushel of corn is equal to that of a bushel of potatoes. I will, however, proceed with my calculation of the comparative value of each, when grown to be consumed on a farm, in the same way as if the nutritive matters found in both, were equal in their nature and properties.

If when potatoes are grown, but three bushels and one-fourth of them are obtained, where one bushel of corn might be as readily grown; and there is no more nutritive matter in four bushels of the former, than there is in one bushel of the latter; the loss of nutritive matter, in consequence of growing one acre of potatoes, in place of growing the same ground in maize, is equal to about fifteen bushels corn.

The fodder of an acre of corn, when rated at eight dollars per

* See note, page 191.

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ton, is, agreeably to the foregoing estimate, worth ten dollars and forty cents; if this sum be laid out in corn at seventy-five cents per bushel, it will bring thirteen bushels and three-fourths.

The extra cost of the seed for a potato crop, has been rated at eight dollars, sixty-two and a half cents; if this be also laid out in corn at seventy-five cents per bushel, it will buy eleven bushels and one-half.

From this statement, it would seem that the farmer loses the value of forty bushels and one-fourth of corn, when he grows potatoes in preference to maize, to be consumed on his farm; beside the expense of feeding this bulky article, which, if it be used raw, ought to be washed. But when he can sell his potatoes at fifty cents for those that are marketable, and twenty cents per bushel for the smaller ones, a crop of this root will be much more profitable to him than a crop of maize. However, an extensive growth of potatoes would quickly glut the market for culinary purposes. If it did not, the gentleman has no prospect of sending them to market, without more vexation and perplexity than they are worth.

Thus it seems that maize should form the principal part of the gentleman's fallow crops: especially, if he finds that my description of the economy of this plant, is founded on nature, reason, and correct practical observation. These seem to determine that maize is not only the most productive and extensively useful of all the corns, but also that is does not exhaust the soil more, if as much, as any of the roots or plants which are commonly grown for feeding cattle through the winter; and that the idea of the exhausting properties of maize, has originated in bad husbandry; aided by the superior excellence of this plant, which enables it to contend with poverty of soil, and to withstand drought and all the unfavourable vicissitudes of the seasons, except an untimely frost, better than any other plant cultivated by us. It also clearly appears that even the frosts of 1816, as far north as the neighbourhood of lake Erie, has not been sufficient to prevent a profitable variety of that plant from getting perfectly hard and sound, although the corn there, as well as in most northerly situations, was either generally destroyed or sadly injured by frost. Nay, more, other corn grown on the same soil, and by the same farmer, yielded but thirty bushels per acre, and this much injured by frost, while the very early and valuable variety produced fifty bushels to the acre, sound and well filled out to the points of the ears.

But if the gentleman's own good sense or any other cause should induce him to avoid growing turnips, beets, cabbage, &c. extensively, and he should escape the certain loss that would follow from growing large quantities of potatoes, and erecting the necessary steaming apparatus for cooking them; and in place of these expensive and injurious practices turn his attention to maize, it may be useful to make some remarks on the probable result.

If he should happen to procure a head man or farmer who is well acquainted with his business, industrious, sober, intelligent and

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honest; with such a man, together with the attention the gentleman may consider necessary to bestow on his business, there can be but little doubt that his crops will be equal, and perhaps superior to the crops of the best full bred farmers in his neighbourhood, and such as would, without question, in the course of time, enrich the cultivator who aided the business with his own labour, together with the labour of his family. Yet, crops obtained through the round of the best common practice, will certainly bring the gentleman very considerably in debt after he has paid the expenditures of the farm, and has charged interest on the money vested in it, and employed thereon, and made due allowance for wear and tear, and deficiency in the value of horses, implements, &c. grown older in his service.

Nothing short of a general *assemblage of the very best productions* and *best cultivation* that is practised in the country, can possibly secure success to the gentleman farmer. These are easily obtained by industriously gleaning every thing that can be discovered valuable in agricultural books, and in the practice of others. Through the medium of this simple, but certain means, the attentive agriculturist may in a short time double the production of his grounds, without risking the uncertainty of farming from theory. He will also obtain from this mode of practice, aided with correct accounts, more real useful information in three or four years, than he could acquire in ten or twelve years in the usual way. In fact, it may be justly said, that by this means, he would in the course of seven years, acquire more knowledge of practical husbandry, than is commonly obtained by the practice of half a century, in the usual course pursued by gentleman farmers. Much more depends on the proper use of time, than on the length of the time employed. Hence it is, that we so often see young men so far outstrip those who have grown grey in the practice of the same profession; for very superior talents are seldom the cause of this marked difference.

Although the agriculture of this country has not been so highly improved as that of Great Britain, there are farmers here, whose industry, ingenuity and crops would claim respectability either in that or any other country; and it must be a poor farm indeed, which exhibits nothing worthy of the keen eye of the industrious and intelligent gleaner. It may cost the gentleman no very inconsiderable share of reading, to obtain all the information he wants; yet after it has been procured it will be invaluable. By reading, he may soon acquire knowledge sufficient to engraft improvements on the best cultivation of his country, which will open full scope for future experiments and industry. How much wiser and safer is such a course than the introduction of foreign plants, or implements of cultivation, with which his workmen are entirely unacquainted, while he himself is incapable of instructing them: still, it is certain, that cautious trials of this sort, in the hands of skilful cultivators, may be rendered highly beneficial to themselves and the agriculture of their country.

Nothing can be more obvious, than that an intelligent workman

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or farmer is absolutely necessary to a gentleman, particularly on the commencement of his business. Yet too generally their habits reduce them to a level with the rest of the workmen. They are too often his intimate associates, and their faults and improprieties of conduct will be concealed, unless it is found necessary to divulge them in order to screen himself.

The gentleman, in the common conduct of his business, must necessarily depend much on the judgment of this man, still his own eye should carefully inspect every thing which is done on the farm. Every order or instruction to his workmen, should emanate immediately from himself. His conduct should convince them, that he did not depend on his farmer to see that his orders were properly executed. It will also be found an invaluable practice to accustom the farmer, and every other workman on the place, to wait on him at a very early hour every morning, for the orders of the day. It will establish early rising, and prevent much loitering before business commences; especially if they are taught to expect that the gentleman's eye will pursue them. The watching of their motions will be attended with much less trouble, after it is known that the gentleman is determined on order, regularity and industry; especially when they discover that every transaction of the farm is registered, and that precedents may be produced of the labour done by others, to expose their idleness. They dread the quill, in the hands of their employer, more than a cudgel, provided the gentleman preserves a dignified, but at the same time, a complaisant conduct, taking care to avoid that trifling familiarity, which naturally insures contempt.

Prudence will dictate the keeping as few workmen as possible during winter, for short days and inclement weather curtail business exceedingly; especially if breakfast is not over in time to commence business soon after it is light. Neither the farmer nor the workmen will be stirring, if they suspect the cultivator is in bed: but it is presumed no gentleman will engage in farming, who does not, sportsman like, value his game in proportion to the ingenuity and exertion which has been employed in the procuring of it. It will certainly be found, that no other characters are fitted for the purpose. A gentleman cannot farm by proxy with any more rational prospect of profit or reputation, than a physician could practice by sitting at home in his easy chair, and sending apprentices to visit his patients.

From what has been advanced, it seems that if the gentleman turns his attention to maize, and depends on his farmer, his crops will bring him considerably in debt. If he resort to books for information, he is not likely to succeed better, if as well, as it will be natural for him to adopt the practice that has obtained the largest product.

As Mr. Stevens's wager crop is the most prolific, it is probable he may determine on his mode of planting. If so, he is taught to believe, that "to do this expeditiously and accurately," he ought to

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"bore two rows of holes in a piece of board, four feet long, so as to form equilateral triangles, the sides of which were seven inches. Into those holes," he is directed to "drive pegs about three and a half inches long," and "as the corn is dropped in the holes made with this machine, a man" should "follow with a basket of rotten dung, with which he fills them up;" then "carts should come on, out of which the rows are to be sprinkled with a coat of manure."* Now it is one hundred to one, whether the gentleman may consider that Mr. Stevens is not, in this experiment, pursuing the economical practice of husbandry, which his knowledge of agriculture would have induced him to adopt, if the profit arising from the product and sale, or use of the crop, had been his only object in this very tedious and expensive business: therefore the board is formed, the holes bored and the pegs driven into the holes. This machine is placed in the hands of a man who has been used to plant corn vastly more expeditiously, and who despises an invention which he readily sees can never be advantageously employed. The man who drops the corn in the holes, also the man who follows with the basket of rotten dung to fill them up, as well as those who come on with the carts to sprinkle the rows with a coat of street manure, all perfectly accord in the same opinion. They despise the ignorance of the employer, and as but few men, (even when they are well paid for it,) can be patient, when compelled to employ five times as much labour as is necessary to accomplish the work they are doing, the gentleman's labourers become impatient, and combine against him, and determine to make him suffer for putting them so far out of their usual way. They are also awkward in a business to which they have not been accustomed. Being likewise determined not to improve, it would, by no means, be wonderful should planting commence at the usual time in May, if it be not finished until some time in June, unless the size of the field be inconsiderable; consequently it is probable that, beside an extensive loss in labour sustained from the very tedious mode of planting, the corn latest planted will be injured by frost. It ought also to be recollected, as before observed, that farmers who possess talents, capital and enterprise, as did Mr. Stevens, frequently obtain by their skill and superior attention to the cultivation of their crops, extensive product, when a very interesting part of their management has been excessively bad. But this is not likely to happen in the commencement of the gentleman's practice. On the contrary, it is probable that either an insufficient or mistaken cultivation, will greatly increase the very baneful effects arising from too thick planting.

But this is not all; for although Mr. Stevens won the wager of fifty guineas depending on these crops, he lost more money than did his competitor, Mr. Ludlow, who lost the bet; provided these gentlemen lived at that distance from town which would fix the price of the manure used by them, at the average cost of that article.

* This is the substance of what is said of Mr. Stevens's mode of planting in the Domes. Encyc. Amer. ed., art. Corn.

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This will centre somewhere between the largest and shortest distances, to which it is annually carried from the cities or towns where it is made.

The land employed by each of them seems to have been three acres. It is said Mr. Stevens applied "seven hundred horse cart loads of street manure," and Mr. Ludlow "two hundred horse cart loads of street dirt;" therefore it would seem that each of these loads was drawn by one horse.

If manure be carried to a considerable distance, it is done cheapest by water, but as it must be often handled and carted twice, when transported in this way, it costs quite as much as land carriage, if the distance be moderate. Therefore, it would seem that to cover the cost in town, also transportation, spreading it over the soil, sixty cents per load is a moderate estimate, without considering the tedious use of baskets, and sprinkling it over the rows:

Mr. Stevens employed five hundred loads more than Mr. Ludlow; this, at sixty cents per load, amounts to		$300 00
Deduct from the above fifty guineas won by Mr. Stevens, or	233 33	
As Mr. Stevens grew sixty bushels of corn more than was grown by Mr. Ludlow, this should also be deducted; at seventy cents per bushel, it amounts to	45 00	
		278 33
Balance lost by Mr. Stevens, although fame has represented him to be the winner,		$21 62

The cause of this is evident: Mr. Stevens planted vastly too thick in the rows, and Mr. Ludlow's arrangement was, saying the least that can be said of it, a good one, when compared with the former gentleman's plan. Mr. Ludlow "planted in continued rows, four feet asunder, and eight inches from stalk to stalk in the rows." And if he had employed only half as much manure as was applied by Mr. Stevens, it is probable he would have won the wager. Now if this had happened, as I believe it would, Mr. Stevens would have lost more than three hundred dollars. However, two things are very evident from the calculations made on these wager crops. First, that even an immense quantity of manure, is not capable of counteracting to any very considerable extent, the fatal error of too many plants. Secondly, that much money may be very readily lost in the random and injudicious cultivation of a few acres of ground, quite as much, or perhaps more, than the value of the land on which the crop is grown; and as the subject seems to be a very interesting one, especially to gentleman farmers, it will be resumed and further considered in my next chapter.

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CHAPTER XLV.

The merit of different systems of cropping and management considered.

If my mixed crop of corn and potatoes, published in the second volume of the Memoirs of the Philadelphia Agricultural Society, claimed the gentleman farmer's attention, he was not likely to do much better by adopting this practice, than that of Mr. Stevens's wager crop of corn, at least not until after I had discovered the error of too close planting, and made it known in the third volume of the Memoirs. However, in this instance, the antidote followed the poison before much time had elapsed. But unfortunately, especially for gentlemen, this too seldom happens; therefore, unless, they become quickly tired of playing a losing game, and abandon farming, they too generally sink immense sums of money before they become acquainted with the economy of that very simple business, which random and irrational practices have rendered complex, and very difficult to be understood.

To explain the causes that led to the errors in my mixed crops, will consume some time and paper, but it may do good. Mr. Stevens' "noble crop" of corn had claimed my serious attention, but it also happened, that I had frequently observed, that the corn plants growing on the extremities of the fields, produced more and larger ears than the plants growing in the interior of them, except when planted near to an adjoining wood or fence. This led to the just conclusion, that a free access of sun and air causes this marked difference, and determined me to plant my corn rows wider apart, and grow potatoes between them. My first attempt was in 1809, but, as commonly happens with new practices, the business was very badly planned, and no better executed. Two rows of potatoes were planted in each interval between the rows of corn which were only eight feet three inches, or half a perch asunder; this arrangement furnished too little soil either for the potatoes or the corn: especially as both these plants were cultivated by the savage practice of ridging them up. My ploughman was the best I have ever had, and always seemed willing to execute my instructions; still as he had never put in a mixed crop before, it was found after the plants came up, that the rows of corn and potatoes in many parts of the field were growing so near to each other, that the plough could not pass between them, without cutting many of them up; this induced me to have the corn plants growing in these places removed and transplanted, so that the plough might pass between them and the potatoes. As the corn did not stand thick in the rows, being planted in clusters eighteen inches asunder, and but three plants suffered

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to remain in any one cluster, the crop on the whole was tolerable, notwithstanding it suffered greatly from very injudicious management.

But unfortunately, though I at that time thought it a very fortunate circumstance, it so happened, that in turning the sod over the potato sets, ridges were formed through several parts of the field, and in planting the corn, several rows of it were accidentally planted immediately on the tops of these ridges, and on them the product seemed to be flattering; this, together with the other circumstances just related, being powerfully backed by the product obtained by Mr. Stevens's close hedge row planting, led me into all the very egregious errors which the reader may see described in my book on Cultivation, commencing at page 161, and continued on to page 164. But as a gentleman in the commencement of his business, cannot readily distinguish between good and bad practices, and the product of my mixed crop grown in 1810 was far from being inconsiderable, it seems to have been well calculated to lead him into error, especially as I had inferred, that a great loss occurred in consequence of a failure in the first planting, also by an error in the construction of the indenting roller, which with other causes reduced the fruitful plants in the field to about one half the number originally designed. It was intended, that sixty-six plants should be left standing on the ridges in the length of one perch along the rows of corn, whereas it appeared, that after deducting the barren plants introduced by replanting, as accurately as this could be readily done, only about one-half the number of fruitful plants were left. Now the true state of the case seems to be simply this, if my soil, together with the advantages that are actually to be derived from a wider space between the rows of corn for the admission of more sun and air, had been as capable of perfecting sixty-six plants in the length of one perch on the ridges, as my estimates seemed to promise, that number of plants would have certainly produced much more corn than thirty-three growing in the same space. But I should have considered that such a great number of roots crowded together were not likely to prosper, notwithstanding all the advantages that might be derived from more sun and air, and from the points of the angles employed by me being made much wider apart than those used by Mr. Stevens, for planting his double rows of corn; however, as the planting did not fail in my crops grown in 1811, they clearly determined, that the crop with only thirty-three fruitful plants in the length of one perch on the ridges, and these standing irregularly, and also incumbered with many barren replanted stalks, would have produced much more corn, if necessity had not urged me to cut the tops, and strip the blades, for feeding my cattle in the yard, before the grain was sufficiently matured, as will appear from a correct experiment made to determine the probable loss sustained, in consequence of too early topping and stripping the plants. The growing of my mixed crop in 1810, did not convince me of the error of too many potato plants. But as the

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soil necessary for covering the seed, together with that used in ridging up the plants, sunk the furrows in many instances below the roots of the plants, the injury sustained by planting them too shallow was very evident, therefore when the result of the crop was communicated, I was careful to observe, that, "the potatoes would have been luxuriant, had it been sufficiently considered that nature had designed them to grow under the ground, for the high planting and dry weather while they were fruiting reduced their usual size considerably." This observation was the candid result of reflecting on the cause of a mortifying disappointment, but it was not until after the growth of my crops in 1811, that I clearly saw that the general system of cultivation was radically wrong, and that the merit of practices highly recommended, especially by books, too generally rested on the capital and active enterprise of those by whom they were first introduced: also, that those evils, together with irrational theories, would never cease to perplex, as well as disappoint the farmer in his best laid plans to improve, of course greatly injure the interests of agriculture, until nature and reason were harmonized in the practice of husbandry. For until this be done, no general fixed principles of cultivation can be established, by which the agriculturist, especially the gentleman farmer, may govern his practice. That these general fixed principles have not been established, seems evident, as the British Board of Agriculture did not contradict Sir H. Davy, when he read before them, that "no general principles can be laid down respecting the comparative merit of the different systems of *cultivation*, and the different system of crops adapted in different districts, unless the chemical nature of the soil, and the physical circumstances to which it is exposed are *fully known*."*

Now it seems that this gentleman might as well have said it was not probable that any general principles could *ever* "be laid down respecting the different systems of cultivation," as to say this could not be done, "unless the chemical nature of the soil, and the physical circumstances to which it is exposed, are *fully known*:" for the world must become infinitely wiser than it now is, before these things are *fully known*.

It is not to be doubted if these very interesting subjects could be, and were, *fully known*, that the interest of agriculture might be greatly promoted by the proper use of this information. It seems, however, from what has been advanced in my book on Manures, that nature has so fixed the general principles of cultivation, that they would have been as obvious as any of the facts which are generally known, if her economy in the grounds that have been subjected for ages to her perfect system of management alone, had been attentively observed and carefully considered. In these grounds it may be readily seen that animal and vegetable matter prepares the texture of every soil to produce luxuriant crops, be

* See his Lec. on Agr. Chem. page 24.

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its earthy ingredients what they may: except where those matters exist in too large quantities, as in peat, &c., and in these cases the remedy is obvious: but as too great an accumulation of animal and vegetable matter does not occur in grounds which have been subjected to cultivation, there is no substantial reason why a general system of cultivation may not be established. There may be soils which are so poisoned with minerals that stable manures will not correct the evil. Such grounds, however, cannot be generally very extensive, as I have never seen any of them. Neither have I observed that chemistry has done any thing more towards correcting offending matters in soils than merely to confirm and better explain what practice and observation had before established: for Sir H. Davy, in enumerating the improvements of steril soils, says, "A soil of good apparent texture from Lincolnshire was put into my hands by Sir J. Banks, as remarkable for sterility: on examining it, I found that it contained sulphate of iron; and I offered the obvious remedy of top dressing with lime, which converts the sulphate into a manure." "If there be an excess of calcareous matter in the soil, it may be improved by the application of sand or clay. Soils too abundant in sand are benefited by the use of clay, or marl, or vegetable matter." "An excess of vegetable matter is to be removed by burning, or to be remedied by the application of earthy materials." "The improvement of peats, or bogs, or marsh lands, must be preceded by draining. Soft black peats, when drained, are often made productive by the mere application of sand or clay as a top dressing. When peats are acid, or contain ferruginous salts, calcareous matter is absolutely necessary to bring them into cultivation. When they abound in the branches and roots of trees, or when their surface entirely consists of living vegetables, the wood or vegetables must either be carried off, or be destroyed by burning. In the last case the ashes afford earthy ingredients fitted to improve the texture of the peat."* Sir H. ought not to have confined the use of the ashes to the mere earthy ingredients furnished by them, as that would be too inconsiderable to do much good, while the alkaline and other salts are very extensively useful. It is also very observable, that he likewise overlooks the value of these salts in paring and burning the soil, while he takes great pains to impress on us the great value to be derived from the charcoal to be obtained by this truly savage practice. In fact it would seem that this gentleman's attempts to overset the rational theory of the action of gypsum, powdered limestones, &c. have led him into much error.

With respect to "the physical circumstances to which" the soil "is exposed," local and hidden causes render these so various, that it is at *least* doubtful whether they will be ever "*fully known.*" But this we may know, that in every climate and situation vegetation seems to be as luxuriant as might be rationally expected to

* See his Lec. on Agr. Chem. page 204.

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be grown in such climates and situations, if a sufficiency of animal and vegetable matters exist in the soil: consequently our imperfect knowledge of what, perhaps, it was never intended should be "*fully known*" by us, can be no bar against the introduction of general principles of cultivation.

Now it is evident that the most which can be said of the foregoing quotation from Sir H. Davy's Agricultural Chemistry, is, that chemical experiment has confirmed and better explained what the talents, observation and enterprise of plain practical farmers had long before brought into actual use. This is by no means surprising: on the contrary, as nature is not partial to any grade of society, in the distribution of talents, it would be wonderful indeed, if an immense number of men actively engaged in any simple employment, the knowledge of which rested principally upon practice and attentive observation, would not attain much more practical information concerning it, than a few whose knowledge of it rested principally on chemical experiment; than which, nothing can be more deceptive. It is, in many cases, not only exceedingly difficult, but seemingly impossible to combine in these experiments, all the known, as well as unknown causes which operate in actual practice: or if these causes were known and could be combined, the necessary proportion of each to form a correct experiment, would be, in many cases, a very difficult question. Witness Sir H. Davy's experiment on charcoal, which seems to have led him into the erroneous opinion, that this substance, when obtained by paring and burning the soil, acted as a powerful manure. Also, witness the conclusions drawn by this gentleman, from his experiment made by mixing gypsum with minced veal. But to return.

If the gentleman should place no more dependance on chemistry, than is justly due to it, and turn his particular attention to the agricultural writings of the most celebrated authors, he will find it equally necessary to sift the chaff from the wheat.

The celebrated A. Young appears to stand, at least, among the foremost on the list. Accident seems to have favoured his fame. He commenced his agricultural career when the mania for gentleman farming in England was spreading far and wide. When he says, "Lawyers, clergymen, soldiers, sailors and merchants" were engaged in husbandry, and "the farming tribe was made up of all ranks from a duke to an apprentice;"* and while but too many of the gentlemen, &c. engaged in the business, knew but litttle or nothing of it. This, together with no small share of talents, aided by an enterprising spirit, and a marked prejudice against the plain practical farmers, whom he not only depreciates, but also degrades lower that any other people in the world,† obtained so much respect for his opinions than his errors have not been sufficiently distinguished or exposed. Although, so far as my information extends, general opinion seems to have determined, that after saying the

* See his Rural Economy, page 93. † Idem, page 92.

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most that could be justly said in favour of the grounds farmed by him, they were very far from exhibiting any marks of superior management; and not to be favourably compared either in point of profit or real (not sordid) economical management with those occupied by many plain practical, or as we have too often called them *common* farmers. There are certainly too many farmers whose practice clearly evinces that they have either no disposition or talents to improve. It matters not if they be degraded. But it is equally certain that there are many farmers whose talents, observation and enterprise do honour to their profession: also, that gentlemen are principally indebted to this class of cultivators for by far the greater part of the useful knowledge they now possess of husbandry; notwithstanding all that may have been written or said to the contrary.

It will be recollected that I write in the back-woods, where books are not plenty. This prevents me from quoting any of Mr. Young's writings, except his essays on "Rural Economy."* That part of this book which advises gentleman farmers to govern their practice by correct farming accounts, and not to rent more land than may be judiciously managed, with the capital they actually possess or mean to employ, is excellent. The arguments used to convince them that nothing can be more fatally deceptive than the too general opinion that farming requires but little capital or experience; especially, when a gentleman who neither works himself nor obtains any laborious assistance from his family, engages in this business, is worthy the pen of Mr. Young, or any other gentleman of talents. As what he advances on this very interesting subject, clearly determines that on this part of the economy of farming, he was well informed.

When Mr. Young describes "that proportioned farm," which he says "is of all others, the most profitable," he observes, "I do not mean to show what farm will yield the greatest income, because in most cases, the largest will, in that respect, be the best; but I would discover if there be not a peculiar *proportion* between the parts, remarkably favourable to profit and convenience, and not in farms only of a certain rent, but in all sorts." "The first division of a farm is into arable and pasture land;" "the arable land requires draught cattle to cultivate it and carry out its products, the grass must be applied to the feeding or fattening of other cattle."†

"Suppose that in stocking of a small farm, that twenty acres of arable land per horse, is the quantity to be managed properly by the team; four horses will in that case, cultivate eighty acres of arable. Now what are the proportions that can be drawn from this one fact? Eighty acres of arable land managed by four horses, may, if the soil is not heavy, be thrown into fourths; one sown every year with turnips, one with spring corn, one with wheat and one with

* It has so happened that this book has found its way here.
† See his Rural Economy, page 8.

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clover; if the soil be heavy, a fallow or some other fallow crop should be substituted instead of turnips. If a fourth be not clover, the four horses cannot be managed properly.

"Before we proceed further, new proportions arise; we will allow each horse two tons of hay per winter, which will leave him a little to spare for summer. This at two mowings, may be reasonably called four acres. For the summer food, we will allow the four horses six acres of green clover. Thus the whole quantity eaten by the four horses, is ten acres. There are twenty acres of stubble for littering the yard; part of the straw of the wheat must be applied to littering the four horses, the rest given to the cattle: here, therefore, is the following winter food; twenty acres of turnips, twenty tons of clover hay, twenty acres of spring corn straw, and part of twenty acres of wheat straw.

"The next inquiry is the cattle these will winter. The food is all well adapted to different kinds; but I shall suppose them heifers, steers, or oxen. The order in which they should be fed, is to give them the wheat straw first with some turnips; next the spring corn straw with some turnips; and then the clover hay with the rest of the turnips; which progression will carry them forward in flesh, and get them in fine order to turn out into grass, to complete the fattening. The number I should assign, in this management, to such a quantity of food is thirty head. Thirty middling steers would be well wintered on this food. The reader will remember they are not fatted, only kept; all that is wanting, is to keep them rather on the improving hand. The quantity of winter food points out in this manner, the number of cattle to be kept, and this will discover the quantity of grass land such a farm ought to have; this is at once determined, for we may allow an acre per beast, or thirty acres." "Thus we find the number of horses a clue to discover the whole economy of a farm."*

This may not only be an ingenious but also a very judicious arrangement in England. Where the prejudices of agriculturists are too generally in favour of old grass grounds and other injurious practices, which make much against the introduction of a better system of arrangement; also, where no plant has yet been successfully cultivated which produces luxuriant crops of grain, and likewise tops and foliage that afford extensive crops of very nutritious fodder for feeding cattle through the winter.

However, to prove that the practice of growing in this country extensive crops of turnips, or other roots, or, in fact, any kind of green food yet known to us except grass, for feeding cattle through the winter, would be very injurious to agriculture, I will divide the number of acres employed by Mr. Young, to wit, one hundred and ten, into sixths. The rotation of crops to proceed as follows:

* See his Rural Economy, pages 9, 10, 11.

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	Acres.		Acres.
Maize,	18⅓	Red clover,	18⅓
Barley,	18⅓	Wheat,	18⅓
		Orchard grass,	18⅓
		Ditto ditto,	18⅓
Annually in grain,	55	Annually in grass,	55

The orchard grass in this arrangement is to be continued two years: consequently eighteen and one-third acres of the sod formed by it will be annually turned up for maize.

For summer feeding the steers,	30 acres of grass.
hay for the horses,	4
summer feeding ditto,	6
part of the winter food for the steers,	15
	55 acres.

This appropriates the whole of the grass, including the clover: consequently the deficiency in the grass grounds to supply the thirty steers with winter food is to be made up by using the fodder obtained from the eighteen and one-third acres of maize also for this purpose.

To estimate the quantity of the remaining products that may be obtained from these grounds, the quality of the soil, and the manures that may be readily obtained, should be considered,

As Mr. Young allots only one acre of ground for summer fattening a middling steer or ox, the ground may be justly considered good, though not of the first quality.

The thirty steers or oxen and four horses littered with the corn stalks and straw obtained from fifty-five acres of land, will furnish a very respectable manuring for eighteen and one-third acres of ground, without the aid of the very heavy expense arising from gathering and hauling large quantities of marl, mould, and anthills, to bottom the yard and mix with the dung, as has been recommended by this gentleman. In his Rural Economy he employs an amazing quantity of soil to be had from anthills, &c. This can only be obtained where a bad system of management suffers the grounds to continue too long in grass; which gives to ants, cutworms, &c. peaceable possession so long, that the multiplication of some of these intruders is often so very great, that paring and burning the soil is frequently considered necessary, unless inferior crops be cultivated until the numbers of the animalcula be very considerably reduced, and the consolidated soil sufficiently pulverised.* But to return.

* Serious inquiries have of late been made in the Farmer's Journal to learn the best means by which anthills are to be destroyed. Britons ought, how-

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If the manure which may be gathered from the system of management that has been recommended be properly ordered, and applied previously to fermentation, it will introduce much more nutriment for plants than can be obtained by mixing it with earths; even supposing the latter to contain more animal and vegetable matter than is generally incorporated with the soils used for this purpose; and that no more time is employed in this expensive practice than will produce a partial decomposition of the animal and vegetable matter contained in the whole mass.

It is also presumed that in this country, where gypsum acts powerfully, that such a soil as Mr. Young has selected, previously manured for the crop of maize, will yield full two tons of clover hay at one mowing; and that the second crop of that grass may be ploughed under for the wheat. This will not only add to the value of that crop, but also greatly promote the growth and prosperity of the orchard grass following it. There will be sufficient litter without incurring the expense of mowing the stubbles. If this were not the case, they should never be mowed where grass seeds have been sown, except where the grass is so luxuriant that it falls while the weather is sufficiently warm to favour a degree of fermentation which would endanger the roots of it.

The stubbles cannot be mowed without cutting off the tops of the grass plants. This retards the growth of the roots of the young grasses amazingly; and as cold weather sets in too soon to admit of much improvement in the extent and size of them after they have recovered from the debility occasioned by this mutilation, nature, when the spring opens, is compelled to apply a considerable proportion of her efforts to multiply and enlarge the roots of the grasses, which ought to be applied to the growth and perfection of their tops. This, with by far too little seed, causes (what we but too often see) the second year's mowing of the grasses greatly to exceed the quantity mowed the first year after the seed has been sown. Yet gentlemen of the first agricultural talents tell us the young grasses should be pastured to thicken the pile: although this is vastly more injurious than the mowing, as the hoofs of the cattle not only sink too freely into ground that has been recently ploughed, but their mouths also pull up many of the plants which cannot yet be firmly established in the soil. It should also be duly appreciated, that the rotting of the stubble and young grasses on the soil will add considerably to the fertility of it.

It is calculated that the fifteen acres of grass appropriated for a part of the winter food for the thirty steers may be twice mowed. But as the plants will be young and vigorous, and growing in an open, free soil, it may happen that the hay made from but one mowing, together with the corn fodder, will be sufficient. If so,

ever, to have long since known thatanthills, catworms, and old grass ground, are inseparable companions.

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I would advise the cultivator to let the second crop rot on the ground. Although pasturing, if properly managed, enriches the soil, mowing and removing the product, exhaust it. Here it may be proper to remark, that the gentleman is not to expect thick, well set grounds soon after they are sown; unless he sows as much seed as will produce as many plants as the grounds are capable of perfecting. It is certainly very inconsiderate to depend either on the seed from the young grasses, or the shoots from their roots, to increase the product. Much of the rent of the land is lost, and the growth of weeds greatly promoted, by this very erroneous practice.

When the superior advantages enumerated above are estimated, seventy-five bushels of maize to the acre may be justly considered a moderate crop. Although this grain often sells in the early part of the winter for less than seventy-five cents per bushel, those farmers who have a sufficient capital to keep it for the market of the ensuing summer, commonly obtain this price, taking one year with another. Forty bushels of barley is but a moderate crop when the grounds and cultivation are good; and ninety cents per bushel does not seem to exceed the average price. Thirty bushels of wheat to the acre may not be far from the mark; although much more is often grown under such favourable circumstances as have been enumerated; and one dollar twenty-five cents per bushel it is presumed will not be considered too high for the average price.

18½ acres of maize at 75 bushels to the acre is -	1375	at	75 is	$ 1031	25
18½ acres of barley at 40 bushels to the acre is - -	733	at	90 is	659	70
18½ acres of wheat at 30 bushels to the acre is - -	550	at	$1 25 is	687	50
The whole number of bush. of gr.	2658			$ 2378	45
Profit on 30 steers winter kept and summer fattened, rated at $ 20 each steer is - -				600	00
				$ 2978	45
Deduct one-half this sum for the whole annual expense of the farm, - - - - -				1489	22½
This leaves a neat clear annual profit of -				$ 1489	22½

Now it should be observed, that those crops are to be obtained by two ploughings, as the barley will be put in by the hoe and tined harrows, and that Mr. Young in his Rural Economy, recommends from four to six ploughings for turnips; three ploughings for barley,

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and one for wheat;* of consequence his management requires about four times as much ploughing, besides ploughing five acres more than is done to obtain the products enumerated above.

This is certainly a very serious additional expense, especially in America, where labour is high; however, in estimating the profit that may be obtained by Mr. Young's system in this country, I will waive this expense, and that of hauling much mould, &c. and heaping, turnin g and mixing composts; also mowing and raking up stubbles, and deduct no more for the expenses of a farm managed as this gentle man directs, than has been deducted above, for the expenses arising on a much more economical management. I would, however, advise the gentleman farmer, to estimate this enormous extra expense correctly, and after this be done, to reflect whether it be possible, that the gentlemen who have so strenuously advised us to grow turnips and other roots extensively in this country for feeding cattle, could have ever had any real practical knowledge of the subject.

The products of Mr. Young's arrangement are as follows:

20 acres of barley, 40 bushels to the acre is 800 bushels, this at 90 cents is - - - - -	$720 00
20 acres of wheat, 30 bushels to the acre is 600 bushels, this at $1 25 is - - - - -	750 00
Profit on 30 steers winter kept, and summer fattened at $20 each steer, - - - - -	600 00
	2070 00
Deduct from this amount for the whole annual expenses of the farm the same sum as is deducted for the same purpose in the former statement,	1489 22½
This leaves a neat clear annual profit of only	$580 77½

The price of land varies exceedingly in this country. The vicinity of a city or town often greatly enhances the price, when no real advantage is to be derived from the situation, except to the huckster, or the gentleman, whose previous habits strongly propel him to have it in his power readily to mix with the busy or fashionable world.

There is also another cause, especially in some parts of Pennsylvania, for lands selling for much more than they are really worth. Some settlements consist principally of farmers, whose rigid, or perhaps sordid economy, has made them more wealthy than other farmers who are equally industrious. These men will give great prices for lands, adjoining, or lying near to their farms. The annual profit that may be derived from the grounds seems not to be sufficiently considered by them, but they have such a great aversion to paying interest on any part of the purchase money, that no reason-

* See Rural Economy, page 143.

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able consideration could induce many of them to buy on those terms.

The last described neighbourhood can have no charms for the gentleman farmer; the former he had better avoid, as it is well calculated to introduce a round of company, and promote ideas in his family, that are entirely inconsistent with the economy of farming, and in fact with the happiness that may be rationally expected from rural pursuits.

This being premised, it is believed that the gentleman may purchase land equal to that described by Mr. Young, on which a good and very comfortable dwelling-house, and other necessary buildings are erected at one hundred dollars per acre.

110 acres of land at 100 dollars per acre, amounts to - - - - - - - -	$11,000 00
Such a farm may be very advantageously managed with a capital of - - - - -	3,000 00
The whole amount of money vested in and employed on the farm will be - - -	$14,000 00

Consequently by the first arrangement of crops, the cultivator will clear something more than ten per cent. on the money vested in his farm, and in the capital necessary to carry it on, whereas by the arrangement recommended by Mr. Young, he would clear but very little more than four per cent; this would make farming a losing game, as no business can be otherwise, that will not clear legal interest on the money employed in it.

It is true the gentleman will obtain a profit over and above the neat clear income of his farm, in consequence of lands rising in proportion to the increased population and prosperity of the country; also in consequence of the great improvement he will make in the soil. But to the latter he is justly entitled, as it is the result of his superior management, and as a considerable proportion of the seeming rise in the value of landed property, originates in the regular depreciation of gold and silver, provided the gentleman's purchase be made in a well settled neighbourhood, the balance over and abovt the depreciation of money seems to be justly due to him, for but few who rent their grounds to others obtain legal interest on the purchase money

If any cause should exist to induce the gentleman to grow any of the plants grown in Great Britain for fallow crops, the horsebean, or a larger variety of that plant, seems to be best, as all the English peas when grown in this country, appear to be eaten by the fly. But as the fodder from the beans, (though sometimes fed to cattle,) does not seem to be sufficiently nutritive for that purpose, the size of the farm should be enlarged by an addition of ten acres, if thirty middling steers or oxen are winter kept and summer fattened. These one hundred and twenty acres should be divided into sixths, to wit:

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	Acres.		Acres.
Beans, - -	20		
Barley, - -	20		
Red clover, - -	-	- - - -	20
Wheat, - -	20		
Orchard grass, -	-	- - - -	20
Do. do. -	-	- - - -	20
Annually in grain,	60	Annually in grass,	60

The society for the encouragement of the arts, adjudged a premium of twenty guineas to L. Magendie, Esq. for growing on fifteen acres, four hundred and seventy-three bushels of horsebeans.* This is not quite thirty-two bushels to the acre; however, it seems probable that if a productive variety of the bean be selected, thirty-two bushels to the acre, may not be too high an estimate for the average product. I believe beans are much less nutritive than maize; but as I am recommending the latter in preference to any plant, when extensive fallow crops are grown, it may be best to rate the price of the beans at seventy-five cents per bushel, which is equal to the price fixed on the maize in the foregoing statement.

20 acres of beans at 32 bushels to the acre, is 640 bushels at 75 cents per bushel, is		$480 00
20 acres of barley at 40 bushels to the acre, is 800 bushels at 90 cents per bushel, is		720 00
20 acres of wheat at 30 bushels to the acre, is 600 bushels at $1 25 cents per bushel, is		750 00
Profit on 30 steers winter kept and summer fattened, at $20 each,		600 00
		$2550 00
Deduct interest on $1000 for 10 additional acres of land,	$60	
Deduct also for the annual expenses of the farm, the same sum as has been deducted for the same purpose in the two foregoing statements,	1489 22½	
		1549 22½
The neat clear annual profit of the farm		$1000 77½

30 acres of grass is allotted to summer fatten the steers or oxen.
20 acres at two mowings is considered enough to furnish hay for winter feeding them.
4 acres is allowed for hay for the four horses.
6 acres for summer feeding them.

60 acres in the whole.

* See Domes. Encyc. art. Bean.

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Mr. Young says, "in respect to the product of hay, it varies from grass, which at one mowing will yield fifteen cwt. (lower than that I think we should not descend,) to that which at two, affords five tons per acre."* Of clover he says, "in mowing, I should fix the extremes, at a ton and a half, and five tons and a half, both at two mowings."† If these calculations be admitted, I am considerably under the mark in allotting twenty acres of grass for furnishing, at two mowings, sixty tons of hay for winter feeding the thirty middling steers or oxen. But in statements of this kind, it is far better to calculate so as to favour the system we mean to oppose. Here it may be proper to remark, that although I follow Mr. Young in allowing ten acres for furnishing grass and hay for the horses, it is more than enough, even when the horses are pastured; and I trust when the subject of soiling is considered, that however uncertain or impracticable that mode of management may appear to be, on an extensive scale in this country, until it be better understood, it will clearly appear that feeding the working cattle in the yard, or in sheds or stables through the summer as well as the winter, will not only save much grass, but labour also; and that five acres will be found more than sufficient for this purpose: still, the gentleman ought not to estimate an additional profit on the five acres saved in this way, for bad seasons curtail crops; therefore he ought always to have a plenty of old hay in store to meet such an occurrence.

Now it would seem from the foregoing statements, that if the cultivator grows hay in the place of turnips for winter feeding his cattle, he will obtain seven per cent. on the money vested in his farm, and in the capital necessary to carry it on, in place of only four per cent. even when beans are grown for his fallow crop: also that the litter obtained from sixty acres of bean and other straw, will be sufficient to make manure for the ensuing fallow crop.

But Mr. Young says, "turnips or cabbages go infinitely further than dry food. I much question whether an acre of turnips will not go further than five, six or seven pounds in hay, and an acre of cabbages far beyond that."‡ When calculations are made on false principles, the conclusions drawn by them must be erroneous; as is evidently the case in this instance; for it cannot be determined whether hay or turnips may be most profitable for feeding cattle through the winter, by comparing the product of an acre of turnips with as much hay as may be bought or sold for five, six or seven pounds, or indeed for any other sum of money.

Wheat and other small grain cannot be profitably grown, unless the weeds be subdued. To do this a naked fallow is laboriously cultivated by too many in England. As this yields nothing, there are also a great many cultivators in that country, who grow fallow crops of turnips for this purpose, although they lack cattle to consume them. Of this, Mr. Young says, "many farmers cultivate turnips with great care, and cultivate fine crops of them, but want cattle in the winter, to feed them to advantage; they are then to be

* See his Rural Economy, page 72. † Idem, page 74. ‡ Idem, pages 65, 66.

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sold to somebody else, and as they must be sold, it is twenty to one to a disadvantage."* This gentleman, when advising graziers to buy turnips for feeding cattle, also says, they "are to be purchased in every part of the kingdom with which I am acquainted, in any quantities."† He rates the value of an acre of turnips from twenty to sixty shillings sterling. The medium of these sums is forty shillings sterling, or eight dollars and eighty-nine cents.

He says nothing in his Rural Economy of the price of hay; however, in 1816, the Farmers' Journal, published in England, quotes the price of this article at from four pounds ten shillings to five pounds; and a friend of mine who lived in England about six years ago, says he gave six pounds six shillings and eight pence per ton for hay. But as it is better to be under than over the mark, I will rate the price of hay at four pounds ten shillings sterling, or twenty dollars per ton. Thus the hay from an acre of grass yielding three tons at two mowings sells for sixty dollars, or for more than six acres of turnips. This is a very great difference; but as turnips may have risen in price since Mr. Young wrote his Rural Economy, it may be best to say, that the hay from an acre of grass will sell for three or four times as much as an acre of turnips. However, notwithstanding this, the bad management of by far too many farmers in England, causes turnips to be plenty at these reduced prices; and it is generally said in that country, (even by gentlemen of talents, who ought to know better,) that turnips are a much cheaper food than hay, for keeping cattle through the winter. But it should be recollected, that writers on agriculture ought not to form calculations on what may be done by a barter or sale, originating in a bad system of management, and that the question should be simply this, to wit: is it more economical to grow grass, or to cultivate turnips for winter feeding cattle? for if the product be consumed on the farm, it certainly matters not, what either the one or the other would sell for in money.

Mr. Young allots twenty acres of turnips, with twenty tons of hay, and a part of the twenty acres of wheat straw for winter keeping the thirty middling steers or oxen mentioned above. "Middling" is a vague term, from which nothing certain can be inferred; however, to make the subject plainer, it is considered proper to remark, that two tons of hay, saying the least that can be readily admitted, will be found fully sufficient to winter feed an ox, or steer, which when fattened on grass alone, will weigh seven hundred pounds; that is, the four quarters of the animal will weigh this, independent of the hide, gut, fat, &c. As sixty tons of hay is no more than should be reasonably expected from twenty acres of such grass grounds as have been described in the foregoing estimate,‡ an acre

* See his Rural Economy, page 9. † Idem, page 59.

‡ That is grass grounds which are in good condition, and which have not been consolidated by time and the hoofs of the cattle, nor overrun by anthills, moss, hardy weeds, &c.

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of grass seems to be equal to an acre of turnips, taking one year with another, for it should be recollected, that although turnips are sometimes very luxuriant, there is no crop cultivated by us, that is more uncertain than this root, and that grass may be justly ranked among the surest crops grown in this country. Also, that when hay has been well secured, it may be safely kept for any reasonable length of time, and if there be more than is wanted, it commands a good price. Whereas turnips, after they have been apparently well secured with great labour and expense, if the weather happens to be unusually warm, or the frosts uncommonly severe, are often greatly injured; it is also obvious, that much of the nutriment contained in them is lost by a very early and rapid growth, either in the latter part of the winter, or in the spring, and that no management yet known to us, can prevent this injury, if the weather happens to be warm: also, that if a surplus be left they can neither be preserved nor sold; and that an acre of grass may be twice mowed, made into hay, and well secured for one-third the money or labour employed in cultivating and securing an acre of turnips properly.

That hay is a very nutritious food for keeping cattle through the winter is seen from what Mr. Young says of it, to wit, "If cows be" the farmer's stock, "whether for the dairy, or for suckling, he must provide winter as well as summer food. I have known some of these farms," that is dairy or suckling farms, "and the common method is to feed them all winter long with hay, and the remains of the last year's grass, which they keep very late for that purpose."* In another place he observes, that for oxen of seventy stone, that is nine hundred and eighty pounds, "the principal winter food purchased should be turnips, if they can be had, and with them straw; if turnips are not to be procured, *straw alone*, which if good, and given them with attention, will improve them, that is they will *thrive*, which is all that is wanting. In the spring each should have a ton of hay, which will bring them into *good flesh*, and *greatly aid* the whole fatting."† The small Welch or Scotch runts, or any other cattle, reared where a lack of sufficient nutritive food, has not only reduced their size, but also habituated them to live, where cattle that have been accustomed to fare much better, would perish by the diseases which seldom fail to accompany a lack of sufficient nutriment, may thrive when wintered on straw alone. But so far as my observation extends, the ox of seventy stone, or indeed of a considerable less size than this, is so far from thriving on straw alone, that he becomes poor on such food, and but too often dies, if the season for feeding on dry fodder happens to be protracted, before sufficient grass has grown to prevent the injury. The cause is obvious, for the size of cattle depends principally on the nutriment provided for them: therefore, those that have been accustomed to live well, cannot be profitably kept on very inferior food: but of this more will be said in the following chapter.

* See his Rural Economy, page 52. † Idem, page 61.

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CHAPTER XLVI.

A description of the effects produced by feeding cattle on straw through the winter. Large farms are more expensive than smaller ones in proportion to size. How gentlemen may improve agriculture generally: also, the systems pursued by the tenants living on their estates. Remarks on improved breeds of cattle, also, on complex and expensive agricultural implements of husbandry.

I do not know how many may have suffered from the inconsiderate advice that has been given by Mr. Young and others, to winter cattle on straw alone. I do, however, know one gentleman who suffered very severely from this practice. He had bought and removed to a farm on which his predecessor, like too many of our farmers, used the plough too freely, and had grown extensive fields of small grain, and but little grass. The gentleman purchased the crops with the farm. As money was plenty, and the practical knowledge of agriculture scarce, he determined to buy cattle to be winter kept on straw; for by this means, he fully expected to make a great deal of manure, with but little expense. His barn, &c. had been modernized, and the cattle were kept in these newly constructed stalls, well secured from the injurious effects of the inclemency of the winter; they were also regularly fed and watered, and allowed a plenty of salt, and when it was discovered that they did not seem to do well, the straw was cut into chaff, but without any apparent good effect. The hollow horn, a disease which seldom fails to attack half famished cattle, became very prevalent among them. A considerable proportion of them died, and those that survived were so low in flesh, that they would not have sold in the spring, for any thing like what they cost in the fall.

Now a gentleman in this situation, naturally inquires of his farmer or workmen, if the assistance of a person well skilled in the diseases of cattle can be obtained. As there are men in almost every neighbourhood who can bleed a horse, and enumerate a number of drenches, that will produce, if they may be believed, wonderful effects, it is twenty to one, but the gentleman's farmer or workmen will tell him, there is a man residing but a few miles distant from the farm, who is considered very skilful, and that he has also been very successful in that profession: of consequence the doctor is sent for, but when he appears in a black leathern apron, with a face near the same colour, the gentleman must be astonished beyond measure, and be at least very doubtful whether it is possible that such talents as had been represented, could lie beneath the outside garb of the figure before him. However, as the cases are desperate, he seems to be compelled to permit the blacksmith to

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try his skill, for he is placed much in the same situation as those incurables, who, after trying all the most eminent physicians in vain, hang their last dying hope on some ignorant quack. It is also by no means improbable, that after the first surprise, the gentlemans hopes may revive, as it is very likely he will recollect that blacksmiths shoe horses, and that this may possibly lead them to study the diseases to which they and other domesticated animals are subject, and also to practice with no small share of skill. That it leads to practice is evident, for the doctor brings his bleeding tools with him, and being permitted to proceed, he quickly covers the gentleman's cattle yard with the blood of his patients; notwithstanding it was evident, that starvation had previously robbed them of by far too much of this necessary ingredient in the animal economy; and although he copies Doctor Sangrado no further in his practice, his drenches are equally as destructive to the poor animals, as copious draughts of warm water to a man in a dropsy. However, this shortens the gentleman's troubles, and the pain of the sufferers, by putting a speedier end to their existence. But he has to pay well for this, as the doctor is really well skilled in forming his bills to suit the pocket of his employer.

The study of the anatomy and diseases of domesticated animals. should form a part of the necessary qualifications of every student of medicine.

The health and preservation of these useful animals, are closely connected with the comfort and happiness of man; and it would be honourable as well as highly important, to rescue them from the hands of those, who, if they were disposed to be better taught, have it not in their power to obtain the necessary information.

Much might be done towards effecting this valuable purpose, without visiting the animals, except in very complicated and dangerous cases; as a rational description of the obvious symptoms, would generally enable the physician to prescribe proper remedies.

Two cases, in point, happened to myself, the first, a three year old ox, which had been too hard worked, after being in a plentiful pasture of young and tender grass. He was taken with an excessive scouring, which soon terminated in frequent and very painful discharges of mucus mixed with blood, very offensive to the smell; and the animal appeared to be in imminent danger. His case was briefly stated in a note to Doctor Dewees, who ordered a drench of six ounces of castor oil and half an ounce of laudanum. This was to be repeated if necessary; but the first dose cured the ox.

The second case was a spirited mare. She had been worked in the forenoon, and evidently much abused by a thoughtless driver. It was also believed that some nerve or nerves had been severely wounded by an inconsiderate stroke, especially as the marks of several severe strokes appeared. Be this, however, as it may, a lock-jaw ensued in the afternoon, attended with a stiffness in her limbs, an unnatural distention of her nostrils, with spasmodic affections in her cheeks, neck, sides and flanks, which produced a powerful com-

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motion in the parts affected. Her jaws were so firmly clinched, that no force which it was considered prudent to apply, was capable of moving them. She was very restless, often lay down and rose again in a short time; and although very desirous to drink, the spasms rendered swallowing impossible.

Every assistance that could be devised, was carefully administered, until the forenoon of the ensuing day, at which time she became unable to rise, and appeared to be in the agonies of death. However, to get rid of what I then thought, the useless importunity of one of my family, Doctor Dewees was again consulted. He observed, Doctor Rush had informed him that he had cured a horse of the lock-jaw, by dashing cold water plentifully over him; and remarked, that as the case was desperate, he would advise this to be done. With the assistance of several men the mare was set on her feet, and with considerable difficulty, conducted to a well near at hand, thirty or perhaps forty bucketsful of cold water were dashed with every possible despatch on her head, neck, back, buttocks, sides and belly, so that no part of her body escaped a profuse bathing. But little, if any, good effect appeared from the first bathing. It was repeated in about two hours, or perhaps less, and it was then thought that the clinching of the jaws was a little relaxed. This gave encouragement to try a third, and before that was finished, she began to bite the grass growing near to her, but her jaws were not yet sufficiently relaxed to permit proper chewing, or the spasms so far subsided as to admit swallowing. Hunger, however, urged her to a continued nibbling at the grass, although it fell out of her mouth without mastication. A fourth bathing enabled her to chew and swallow, and the next day she appeared to be well, but rather thin and hollow. It is now more than three years since this happened, and the mare has been as healthy and active as she was before the lock-jaw took place. During the intervals of the baths, and for two or three days after she recovered, she was kept covered with a blanket; but as it was thought grass would be better for her than hay, she was not put into the stable.

It is highly important, especially in this country, where labour is scarce, that a gentleman should not encounter an extensive farm, as neither pleasure, profit nor reputation is to be expected from such an undertaking; but as this opinion is immediately opposed to that of the celebrated Arthur Young, and those who have adopted his plans, it is considered best to show, that this practice is not only very injurious in this country, but also in England, where labour is plenty.

In fact it would seem that notwithstanding the taxes have been very high, and consequently very injurious to the agriculture of that country, the uniting several farms into one, and letting these extensive establishments to such farmers, or, as Mr. Young calls them, "gentlemen" who can command large capitals, has been more injurious to the husbandry of Great Britain, than the increase of the taxes, of which the monopolizing farmers in that country so louldly

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complain. The cause seems to be evident, for neither the gentleman who occupies the farm, nor any part of his family, labours. On the contrary, he hires a bailiff to overlook the workmen, and superintend the business of the farm. Of this, Mr. Young observes, that "unless a gentleman reduces his business to very great simplicity, he will find too great fatigue and too constant assiduity requisite, to render farming of considerable profit. Keeping all the people employed strictly to their bargains; overlooking the servants as to their hours of ploughing and other work, and likewise the manner every thing is done in, with a variety of other articles, require an unceasing attendance: no gentleman that keeps any company, or indeed that amuses himself with any thing besides his business, can perform it, and he must employ a bailiff whatever be his opinion:"* also that "a gentleman who does not employ a person of this sort must, so far from rendering his business a pleasure, submit to it as a slave. He must be absent from home no more than the lowest farmer; and he must at all seasons, *hours* and *weathers*, attend to *every* motion of his people. He must ride about the country to fairs, he must frequent markets;† in a word, he must let himself down to the lowest company, and if he has the least taste or ideas of a gentleman, suffer continual uneasiness."‡ Here I would ask who is the gentleman that Mr. Young thus advises? is he the owner of this extensive farm? No, he has to pay a high rent to the proprietor of the soil, with the addition of very heavy taxes; and but too frequently makes expensive alterations or improvements, before the premises meet his extensive, and too often mistaken, ideas of profit and convenience.

Can Mr. Young seriously expect that the gentleman's bailiff will, at "all seasons, *hours* and *weathers*, attend to *every motion* of his people?" This is not likely to happen, especially as he remarks, that "the idea common in most countries is, that of nine bailiffs out of ten being knaves; which notion could not become general without some foundation in truth."‖ But in fact it is not to be expected that even an honest and industrious bailiff or farmer, who superintends his own business, "will, at all seasons, *hours* and *weathers*, attend to *every motion* of the people under his care." Neither is this necessary, except on some particular occasions; for when it is known that the gentleman gives proper attention to his business, and knows what may and ought to be done, his workmen will respect his talents, and soon be convinced that an attempt to deceive him, would terminate in their being detected and exposed.

* See his Rural Economy, page 103.

† Mr. Young cannot mean the market where provision is huckstered out for family use. It must be the cattle, corn markets, &c. to which he alludes, for he observes in his Rural Economy, page 123, "a bailiff has a greater opportunity of buying and selling, than in any other business, for which reason, that part of his business should be as much contracted as possible;" and to prevent this evil, whenever it can be done, he advises, that "as soon as the whole crop is threshed out, it should be sold by one sample."

‡ See his Rural Economy, page 100. ‖ Idem, page 99.

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If the gentleman's previous habits, or the love of "company," or as it is sometimes termed, a cheerful glass of wine, unfits him for the other attentions enumerated by Mr. Young, it would be far better to vest his capital, and employ his talents in some business that would allow him more leisure, and yield him a more extensive profit than is to be rationally expected from farming.

What may, or may not be the "taste or ideas of a gentleman," is of but little consequence, so far as the interest of agriculture be concerned. But it is certainly paying no compliment, either to the talents, prudence, or propensities of a gentleman, to say that because "he must ride to fairs, and frequent markets," "he must" also "let himself down to the lowest company." However, as it is thought that a gentleman "lets himself down" if he attends to his own business, high wages are given to a man that can do it for him, and who, ("it is twenty to one," if Mr. Young be correct,) will also cheat him roundly into the bargain. The gentleman's family must also be genteelly clothed and fed; his children genteelly educated; wine, with attendance on cattle shows, plough races, &c. are also very serious items in rural economy. Whereas the plain practical farmer not only sees to his own business, but also labours himself, and is assisted by every member of his family, not excepting his younger children, so soon as they are capable of doing any thing useful. In fact the difference in expense between the two establishments, seems to be more than equal to the rent of the soil; if so, the owners of land in England, by establishing a middle grade of gentry between themselves and the people who labour on their lands, act unwisely.

But notwithstanding this heavy and worst of all taxes, that has yet been saddled on the back of the husbandry of England, to wit: a numerous tribe of *idle hands*, with mouths and backs to be expensively fed and clothed, great improvements were made in agriculture during the long state of warfare, in which that country had been involved previously to the late general peace. Although it would seem that many of these improvements were too expensive to be profitable, when peace and a free commercial intercourse with other nations, should reduce the price of the products of the soil, nearer to a level with the current prices of the rest of the world, it appears that the monopolizers of farms acted as speculators generally do, especially when playing a new and untried game. That is, they did not sufficiently consider the natural consequence of these wild speculations, nor what must sooner or later certainly happen; and as farms were diligently sought after, rents rose in proportion to the increased demand. However, the fleets, armies and colonies of England required immense supplies of provisions, and as large armies were kept up, with rapine and destruction marking their footsteps, in other parts of the globe, the English farmer readily obtained an exorbitant price for the products of his farm. This fallacious appearance of an increased profit on husbandry, seemed generally to confirm Mr. Young's opinions, that extensive farms were by far the most profitable; not only to those

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who cultivated them, but likewise to the nation and the proprietors of the soil: also, that common farmers are "the *most* contracted and *most* ignorant set of people in the world;"* they "love to grope in the dark: it is the business of superior minds, to start beyond the age and shine forth, to dissipate the night that involves them:"† "to suppose them what they ought to be, and always urge them accordingly, would at last be nothing more than hewing blocks with a razor."‡ From this and Mr. Young's writings generally, we may see the very contemptuous opinion he entertains of the talents of common farmers, and also how highly he estimates his own. Yet this gentleman has bound up, and published with his Rural Economy, "The Rural Socrates, or a description of the economical conduct of a country philosopher;" the self-taught Kliyogg, a farmer in Switzerland, whose economy, superior management and unassuming talents, do honour to that class of people, whom Mr. Young endeavours to degrade lower than any other "set of people in the world."

Mr. Young should have recollected before he made this unfounded assertion, that he had elsewhere said "the most valuable discoveries that have been made in philosophy and mechanics, have been the effect of chance; a lesson, by the by, not a little humiliating to the human mind."‖ Now, if this be the case, the plain practical farmer, who is personally acquainted with every thing that is done on his farm, must have a far better opportunity of observing, and profiting by whatever chance may happen to unfold, than the man of science, or the gentleman farmer, who is not as actively engaged, or as intimately acquainted with the various occurrences that take place on a farm. Be this, however, as it may, I do not recollect a single useful practice in husbandry, that originated in science or in gentleman farming. That gentlemen have made improvements on practices that had already been discovered, I am ready to acknowledge, but that plain practical farmers have done the same, is equally obvious.§

But to return. To forward the views of the ministry, the purse strings of England were liberally opened to her allies on the continent, which, with other enormous expenditures, compelled them to negotiate extensive loans; this caused the paper currency to depreciate considerably However, it was plenty, and farmers felt but little inconvenience from the depreciation until after the general peace. After peace was established, government no longer wanted extensive supplies, and business generally was greatly depressed in consequence of the sudden change; grain was also introduced from foreign countries, where it could be grown much cheaper than in England. These occurrences, as might and ought to have been ex-

* See his Rural Economy, page 92. † Idem, page 22.
‡ Idem, page 51. ‖ Idem, page 182.
§ Witness Mr. Ducket, who is nothing more nor less, than a good, plain, practical farmer, and yet Mr Young quotes his practice when addressing the British Board of Agriculture, on a subject highly interesting to the agriculture of that country.

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pected, greatly reduced the prices of the product of the soil, and caused many farmers to fail, and others to be severely injured.

It is said by a writer in the Farmer's Journal,* that "it had been fully demonstrated to the several committees of the lords and commons, that an average of eighty shillings per quarter of wheat, was requisite to remunerate the grower in this country;" that is ten shillings sterling, or two dollars twenty-two cents per bushel.* By another writer it is observed, "Look at the present state of the English market, they," that is foreigners, "undersell us in our own market, peace appears to have put us in a situation we could not have expected; we could not have believed that grain might be grown on the continent at half the price we can grow it in our own country."† Another writer says, "The foreign agriculturist is really so much against the English farmer, that the latter cannot bring the product of his own soil, and in his own market, at one-half the price that even a Frenchman can supply us."

From these quotations, and many hundreds of publications on this subject, it clearly appears to be a well substantiated fact, that the British agriculturist cannot afford to bring the products of his own soil into his own market, at any thing like as low prices as it can be done by foreigners.

It also seems that this is in England a surprising event; likewise, that the cause is not well understood. For it is said, "peace appears to have put us in a situation we could not have expected; we could not have believed that grain might be grown on the continent at half the price we can grow it in our own country."

If peace had placed the British agriculturist in the situation of which he complains, the same cause would have produced the same effects in other countries; but the fact is simply this: the increased taxes, and the rise in rent, together with the creation of a middle grade of gentry, to be extravagantly maintained by the products of the soil, are the causes that produced this "surprising" effect. The most obnoxious of the increased taxes have been removed, and the rise in rent will be abated, so soon as the owners of lands are convinced that they must lie idle unless this be done. Still if I am not much mistaken, it will be found that foreigners, whose rents and taxes are not higher than the rents and taxes in England, will be able to undersell the cultivators of that country, in their own markets, while husbandry is saddled with the maintenance of the late created middle grade of gentry, or monopolizers of farms. However, of this great evil, or enormous tax, I have neither seen any thing written, nor heard any thing said, nor even hinted, except by one plain practical farmer. As what he advances on the present distressed situation of the agriculture of that country appears to be the result of long practice, and very judicious observation, I will transcribe a part of his communication published in the Farmer's Journal.‡ This gentleman says, "The situation of the agricultu-

* Published in London 22d January, 1816. † Idem, 24th June, 1816.
‡ Published in London, 13th May, 1816.

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rist not having been taken up in any way that I have seen, which states the true cause, I will, although totally unused to writing, venture, from calculations taken from my own practice for fifty years, to give my own opinion thereon, and state the only immediate relief that I think can be given.

"In the early part of my life, my rent varied but little, indeed I had no advance until the last seven years, and when I sold my wheat at five shillings and six pence a bushel," equal to one dollar twenty two cents, "and which I did for thirty years prior to the year 1795, I was making from twelve to fourteen per cent. of my capital. I have since been advanced more than double, and the last two years and a half been losing more than the advance, in addition to the reduction in the price of stock; and as my landlord seems not disposed to allow an abatement accordingly, I am leaving the business, at least all the land I rent, seeing nothing but ruin before me; but if my landlord would reduce the rent to the same price as before, and accordingly as lands in general were let twenty years ago, I am sure I would go on without loss at the present price of corn, and indeed with a moderate gain, although many assert the prices will pay nothing towards rent; but not to drink wine at six shillings a bottle, what was never intended for those who have to live by their industry only, or to keep a first rate hunter, but to drink good potent malt liquor." "All classes, except the poor, have benefited by the times, and now the causes are done away, all should bear their proportion, and retrench accordingly. I am no theorist or politician, but having always understood, that our security depends on our wooden walls, I do not see how they can be supported without commerce, and that raising the price of provisions by bounties, &c. will not increase our commerce, or set the hundreds of thousands of manufacturers to work now out of employ."

Wine at six shillings sterling per bottle is about equal to the average value of a bushel of wheat, but it is not only the cost of this article, and a first rate hunter which are to be estimated, as uniformity requires that other expenditures should be regulated by the same scale: consequently they cannot be consistent with the economy that ought to be practised by a renter of land in any country.

Mr. Young says, "To have every thing complete and well contrived for mutual support, a farm must be a large one. But here I am sensible of the disadvantage of moving upon untrodden ground, and I feel at every step the want of former writers, to take warning by their mistakes: nor is it any mortification to me to think that my humble labours will, in future times, be no more than a canvass for others to paint on. I shall at least be a canvass, which is more than any other writer is to me."*

* See his Rural Economy, page 13. The pencil of time is generally most correct; and no question but it will do ample justice to Mr. Young's canvass or plans.

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Now it appears that the owners of lands, and also the monopolizers of farms, have followed this gentleman "upon untrodden ground." As the quagmire and quicksands were hidden by a deceptive covering, the guide as well as his followers have stuck fast in the mire: also, that he either has not candour sufficient to advise his followers to retrace their steps, or does not know that this ought to be done, seems to be evident from the following observations made in the Farmer's Journal. The writer says, "In your Journal of the 22d ult. is a letter from Mr. Arthur Young, to which, as it appears to have been written for the information of your town readers, I have paid some little attention. From Mr. Young I naturally looked for *argument*, and it was by no means too much to expect from him something which would throw light on a subject so much discussed. All I can learn from Mr. Young, is, that in the years 1812 and 1813 the farmers received good prices for corn, and were well off; therefore, if by some means or other, produce can be screwed up to the same nominal pitch, all will again be right." "After all Mr. Young's laudable exertions for the improvement and extension of our agriculture, he can scarcely suppose that other nations would send corn and undersell us, unless some great advantage was on the side of the foreign grower." "Mr. Young confirms what we have been so often told of the great increase of the poor rate, but he must investigate cause and effect much deeper before he convinces his town readers that this has happened during a period in which, according to common ideas, they ought to have fallen greatly." "If I understand the latter part of Mr. Young's letter, he recommends, with Mr. Western, "increasing the cultivation of the kingdom by the issue of exchequer bills. This will assuredly form a new era in the annals of agriculture. Such a mass of contradiction has this question called forth, that I really cannot in any way reconcile such jarring opinions without supposing the real truth is carefully kept in the back ground."*

It would seem that Mr. Young considers about 1400 acres of land no more than sufficient "to have every thing complete and well contrived for mutual support." Also, that a large farm may be cultivated with much less expense than a small one in proportion to the size. Now, as common sense, observation and practice clearly determine that the reverse of this is true, it is difficult to imagine how this irrational theory has obtained such general credit with the owners of land in England.

This gentleman admits that there is such a thing as a proper proportion in a small, as well as in a large, farm. If he did not, the fact would not be less true, as theories cannot alter the nature of things.

It requires two horses to plough: consequently a less number of acres than can be properly cultivated by a pair of draught cattle, would insure a useless expense. However, as I have no practical

* See Farmer's Journal, published in London May 20, 1816.

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acquaintance with the economy of a farm that requires but two horses, I cannot judge so well of the advantages or disadvantages of so small an establishment, but believe it has been found to answer a very valuable purpose with those whose capital would not admit them to extend their views further. Practice, as well as observation, induces me to believe, that as much land as can be well cultivated by four horses may be managed as advantageously as any other given number of acres; and no question with much less expense, in proportion to size, than a farm of 1400 acres. The reasons are so very obvious, that it really seems not only strange but wonderful, that any farmer possessing common sense should be of a contrary opinion. Supposing a farm of 1400 acres to be square, and the buildings, cattle yard, &c. erected in the centre it, the distance from the centre to the extremities on either side of the farm would be nearly three times further than from the centre of a square of 120 acres to the lines on either side of it: consequently each ploughman, labourer, ploughhorse, &c. has to travel on an average three times as far in going to, and returning from, their work on the larger farm. Every load of manure, grain, hay, &c. is also to be hauled nearly three times as far; the draught cattle, milch cows, &c. are to be driven nearly three times as far, both to and from pasture. The sheep and other live stock in distant fields, as well as the crops growing on them, and which may be greatly injured by cattle breaking into them, require much more time, and of course expense, to watch and take proper care of them. When the farmer's live stock, fields of grain, &c. lie near to his dwelling, they are so often seen in the usual routine of his business, that it is but seldom necessary to pay any very particular attention to them. His labourers are few, except it be in hay time and harvest: therefore he can generally be with them. If he be a plain practical farmer, it frequently happens that himself and his family do nearly all the work that is done on the farm, except when hay and grain are to be cut and secured. In this case, his expense for labour is so trivial that he scarcely feels it. He also escapes much of the trouble arising from workmen; and the few he hires not only labour much more diligently, but also behave much better than they would do on a farm where a multitude of working people must be introduced, and where they corrupt each other. They also become better citizens from the orderly habits acquired by an intercourse with a respectable farmer's family. Whereas extensive farming establishments, like manufactories, are nurseries for vice: especially when carried on by a gentleman; for the working people are not only numerous, but are also so far removed from an intercourse with his family, that they derive little, or perhaps no benefit, from mixing with it.* Certain it is, that the poor rates in England have

* Mr. Young says, in his Rural Economy, page 113, "A farmer who *lives* with his men, and, perhaps, *works* with them, will be always much better obeyed. This point, I must own, has *troubled* me more than once; nor could I ever manage to be totally at *ease* respecting it. There is no part of farming

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very greatly increased since large farming establishments have been generally formed in that country: also, that to degrade is to demoralize, and to demoralize is to make poor. Here it may be asked, if the farmer and his family in many cases, will be sufficiently numerous to perform the principal part of the labour done on the farm, except in hay time and harvest, what is to become of the suffering poor: to create no more is the best way that can be devised to get rid of them. But humanity demands that those who have been created by a bad system of management should be humanely supported in the most economical way that can be devised consistent with their feelings as men, and a plentiful supply. Such labour as they are capable of performing without opppression, they ought to do, for this will not only lessen the expense, but also add to their comfort, as idleness, without pleasing amusement, is an insupportable burden.

Here I will again remind the reader that I write in the backwoods, where books are not plenty. Therefore, have, in some instances, to depend on memory, which may not, in all cases, be exactly correct. If I recollect right, Sir J. Sinclair, in his writings on agriculture, does not approve of the large farming establishments recommended by Mr. Young, and quotes the small, but very perfectly cultivated farms of Flanders and Brabant, to establish his opinion. However, as if led into error by the then seemingly prosperous state of gentleman farming, he deviates widely from the rural economy of Brabant and Flanders; for if my memory be correct, he admits that even larger farms than were recommended by Mr. Young, might be advantageously cultivated. But I trust enough has been advanced to convince the gentleman farmer in this country, and it is him that I mean to instruct, that one hundred or one hundred and twenty acres of cleared ground would form a far more productive farm, in proportion to size and capital; especially as he must

so *irksome* and *provoking* to a gentleman; he cannot take a walk or ride without having proofs that *every* farmer around him has *more work* for *his money* than he has." This single circumstance should have taught Mr. Young who were the men best calculated to cultivate the soil advantageously, if, in place of being abused, they were kindly and rationally instructed in the genuine principles of rural economy. It is evident, that in a very important part of the economy of farming, this gentleman is compelled to confess, that the very men who he says "love to grope in the dark," manage infinitely better than those "superior minds, who start beyond the age and shine forth to dissipate the night that involves them." But, unfortunately for the interests of agriculture, (especially as Mr. Young's opinions seem to have too long governed the farming world,) he appears to have seen the management of the plain practical farmer with a jaundiced eye, and "*irksome*" and "*provoking*" sensations are excited by the laudable enterprise of these men, merely because the nature of things is not changed to further his inconsiderate plans: for the practice and observation of ages clearly determine, that this change must take place before a gentleman who hires another to superintend his labourers, will get any thing like as much work done for the same money, as the man who diligently attends to, and sees after, his own business himself; more especially if himself and his family labour with them.

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have seen that no people under the sun are so independent as the thrifty practical farmers in those parts of the United States, where slavery has been abolished: also that their farms seldom exceed one hundred and twenty acres of cleared land. Likewise, that the principal part of the labour done on the farm, is performed by the farmer and his family, except in time of grain and hay harvests, when they are sufficiently numerous to accomplish this invaluable purpose.

Mr. Young's zeal to get rid of common farmers, whom he considers the "most ignorant set of people in the world," and to enlist the gentleman whose talents he highly appreciates, might have induced him to imagine there were advantages in a large farm which did not exist. Also, too hastily to pass over the very great mass of extra labour that is necessarily introduced by greatly increasing the distance from the centre to the extremities of a farm; especially as he acknowledges that he is "moving on untrodden ground," and must have known full well that the previous habits of the gentleman and his family were such, that they could not live on the neat clear income of a farm for which a considerable rent and taxes must be paid, unless the size of it was very extensive. But it is difficult to devise, why Mr. Young should, among other imaginary "economical" arrangements of this extensive system of "economy" recommend, that "two oxen should be constantly kept at cart the whole year round, with small three wheeled carts, in carrying out dung, clay, composts, &c."* Of this part of his "economical" management, and other "economy" connected with it, he observes, "I allowed one team for carting dung, the year round, and extras of cattle to the amount of another. A team and two small three wheeled carts will carry, at an average, thirty loads a day, or rather half loads, as these carts do not hold above half a load; that is, when the drive is not long; in other cases, larger carts are to be used, and the teams thrown together. In the whole, it is sixty small loads per day, or thirty common ones."† And again he says "the small three wheeled tumbrils are so extremely handy, that a man and a lad will manage two sets of them."‡

It would seem from this complex and very expensive management, but as we are taught to believe, very simple and "economical" arrangement of a large farm "well contrived for mutual support," that "when the drive is not long" twelve wheels fixed to four carts, each drawn by one ox, are to haul four half loads, but when the drive is long, the teams are doubled, and two large carts, each hauling a full load, are used, and that in this case, two carts with only four wheels, are made to haul as much as would be hauled to the same distance, and in the same time, by the same oxen, with twelve wheels fixed to four carts. Thus, six carts, having sixteen wheels, are provided to be used by two pair of oxen:

* See his Rural Economy, page 15. † Idem, page 29 and 30.
‡ Idem, page 32.

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consequently, this "economical" arrangement, saddles the farm with the useless expense of four useless carts, having in the whole, twelve useless wheels.

Now if plain practical farmers were to employ six carts having sixteen wheels, and as it also too often happens, expensive harness in place of yokes and bows, to do the same work that might be as soon and as well done by two carts with only four wheels, Mr. Young might, with some apparent propriety, assert, that they were the "most ignorant set of people in the world." But in fact, such preposterous arrangements are only to be found in the annals of gentleman farming, where it must be confessed, practices equally as absurd, are very much multiplied.

There is just as much use for a third wheel to a cart, as there is for a fifth wheel to a coach. The only rational argument in favour of one horse carts, is, that the animal is placed nearer to his load. However, a curricle furnishes principles by which two horses may be fixed as near to their load in a cart, as one, and with much less expense than adding a third wheel to it. The third wheel places the horse further from his load, and causes more friction: consequently, more resistance, and increases the price of the cart. An ox will haul more when a moderate weight rests on his neck, so will also a horse when the same rests on his back. But it should be remembered that this weight becomes burdensome, unless it be moderate.

There are many gentlemen in this country, who possess extensive landed estates, and still many more who own much more land than can be profitably cultivated by them. If those gentleman, in place of copying the practice of too many of the owners of land in England, would be content to cultivate a small farm, and set the example of strict economy in every department of agriculture, while they at the same time, endeavoured to introduce the best plants, with the best cultivation and practices that are to be found in the country, no question but it would be the means of getting their estates highly improved, with but little expense or trouble to themselves. But, if they hope to succeed, their first efforts should be to remove the prejudice that generally exists among plain practical farmers, (and not without cause,) against the useless as well as unprofitable and sometimes ruinous expense, which is but too commonly attached to, and closely interwoven with, the economy of gentleman farming. This may, however, be readily effected by observing an opposite mode of management. Every department of the farm should exhibit the evident marks of simple rural economy. To prevent the idea that it derived even the smallest assistance from his family establishment, I would advise, that the servants and horses kept for the use of the family, be not, on any occasion, suffered to assist in the business done on the farm.

If such establishments were formed and properly conducted, in the different parts of the country, where gentlemen possessed considerable landed estates, they would not only supersede the pat-

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tern farms which have been projected, but also far exceed any plan of that kind which has yet been proposed. As they would reduce to actual practice, the best as well as the most economical and profitable modes of management: for these establishments would be numerous, and the owners of them might, to a certain distance, readily correspond with each other, and form such plans, that but few valuable plants, or economical and profitable practices, would escape their united attention.

Agriculture cannot be profitably improved by the cultivation of very extensive farms, for which, the gentleman must depend more on the practice and observation of his bailiff, than can be consistent with obtaining correct economical information of this interesting employment. Neither can it be profitably improved by the introduction of extensive flocks of the improved breeds of domesticated animals, purchased at exorbitant prices, to stock a large farm; nor by numerous complex and expensive implements of husbandry; nor by the splendid exhibitions at cattle shows, sheep shearings and plough races. These may display the splendour and munificence of the opulent, without any serious injury to them; but must at the same time greatly injure gentlemen of slender fortune; especially, as by far too many of the latter class of cultivators endeavour to equal, or surpass the rich. In fact, these practices, like fox hunting and horseracing, are well calculated to introduce such idle, expensive and dissipated habits as are entirely inconsistent with the economy of farming.

But as the effects produced by these and many other injurious practices introduced by gentleman farming, are now very seriously felt in England, there is reason to hope that gentlemen will ere long discover, that to have the fruits of the earth in abundance, and at such reasonable prices as will insure the prosperity of agriculture, manufactures and commerce, the cultivators of the soil, must be a hardy, active, laborious, intelligent and independent race of men; and that if gentlemen attempt to employ their superior means of obtaining more extensive information in instructing these men, it should be done in that way which is best calculated to confirm their habits of economy, and also direct the application of these economical principles to objects of rational improvement, well calculated to reduce expense and to increase the revenue of their farms.

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CHAPTER XLVII.

On deep ploughing. Doctor Anderson's mode of planting potatoes considered. Remarks on purchasing and rearing cattle. Very great advantages are obtained by keeping correct farming accounts. How those accounts may be kept with but little writing or trouble. The great use of keeping a regular diary explained.

The gentleman farmer is justly taught to believe, that the farmers in this country, generally plough too shallow; but, unfortunately, he is also instructed to run into the contrary extreme. He is taught to trench plough a worn out soil, for the express purpose of improving it; than which, nothing can be more erroneous. However, this does no very serious injury to the crops, so far as a sufficiency of enriching manure has been spread; but where his soil is thin, and enriching manure has not been applied, the crops, as well as the soil, are greatly injured by this very inconsiderate practice.

Some very whimsical as well as very injurious occurrences have originated in this silly practice. A gentleman with whom I was well acquainted, from a fatal error either in his reading or memory, ploughed in his seed wheat so deep that none of it came up, except some scattering plants between the seams of the furrow slices. An old full bred farmer, whose land adjoined the gentleman's grounds, observing what the ploughmen were doing, ventured to call and inform him that the wheat would not come up. The gentleman treated him very politely, and wine with other liquors were introduced. But at the same time frankly informed him that the farmers in this country did not understand agriculture, and that he had resolved to introduce and recommend British husbandry by his practice among them. The farmer, of course, never ventured after this, to advise his wiser neighbour, on any future occasion. However, the gentleman, as might be expected, soon became tired of farming, and removed back to town.

I was also informed that another gentleman, not far from my former residence, whose ploughmen were none of the best, was resolved to introduce, what he supposed to be, British husbandry. But finding that deep ploughing occasioned crooked work, actually stretched a line to govern them in turning each furrow slice. This appears to be tedious work, but when the pocket is full, and the scull rather empty of agricultural information, or the brain affected by the sudden change from the confined air of the city, to the pure air of the country, folly too often predominates, even in the heads of wise and well informed men, who are capable of transacting any

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kind of business with which they are practically acquainted, to the utmost possible advantage.

I have before explained why a thin soil should not be ploughed deep. Whether English or American writers on husbandry have been most successful in propagating this injurious error among gentlemen farmers, is unknown to me. But I find a premium is offered in the first volume of the Memoirs of the Philadelphia Agricultural Society, for "the greatest quantity of trench ploughed *worn out* land, not less than five acres. The trenching not less than ten inches deep;" "manure admitted; but the best products, with the least artificial manure, will be preferred."*

Mr. Caleb Kirk, a plain practical farmer, ventured to observe, that, "as to trench ploughing, I am fully of opinion twelve inches is a depth too great to bury a scanty soil, except the farmer has a great store of manure to dress his fields after ploughing."† I know nothing of Mr. Kirk, but this opinion will stand the test of reason and practical observation. However, Judge Peters, in his remarks on Mr. Kirk's communication, says, "turning down fertile vegetable mould, would be a most reprehensible operation. *It is* therefore only to worn and infested fields, that I ever recommended the application of this practice." "I could never prevail on a tenant to trench plough, though he enjoyed the advantages of my labour and expense. I am therefore, neither surprised or mortified by Mr. Kirk's disapprobation."‡ Now the question is, who would the uninformed gentleman believe? Certainly the President; especially as he couples Mr. Kirk, and of consequence his talents, with his tenants, whom he often informs us, farm wretchedly, and whom, he also tells us in the same page, he "always far exceeds in products." However, it is worthy of remark, that Mr. Peters must have been very unfortunate in the selection of his tenants, or the whole of them could not be so stupid, as to neglect the many advantages which he says are to be derived from trench ploughing poor soils; especially as they had a full opportunity of observing the profitable result of his practice, and might, if I understand him, have "enjoyed the advantages of his labour and expense," in this very profitable enterprise.

If the reader, however, will peruse what is said in the first volume of the Memoirs, on trench ploughing, I believe he will agree with me, that it seems as if the President had, in the commencement of this wild scheme, expected to make poor land rich, by "burying the old soil," which he very erroneously says, is "exhausted of every fertilizing quality;" and also destroying, as he inconsiderately terms them, "the seeds of *pestiferous* weeds, and *indestructible stocks* and roots, with the bulbs and seeds of garlic, St. John's wort and the daisy, and *other such otherwise unconquerable hosts* of *foes* to his culture of profitable crops;"‖ but being

* See said vol. pages 37, 39. † Idem, page 85. ‡ Idem, pages 241, 242.
‖ Idem, page 240.

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disappointed in this irrational undertaking, he has abandoned the ruinous project.

That he has been disappointed clearly appears, as in the second volume of the Memoirs, we find him busily engaged in destroying, as he calls them, "*pestiferous, unconquerable, indestructible* bulbs, and *hosts* of *foes* to his culture of profitable crops," which in despite of his *ill judged* efforts had again taken possession of at least one of his fields that had been trench ploughed. And we also find him, in the second and third volumes of Memoirs, ploughing only from five to seven inches deep.

But unfortunately for gentlemen, they are incapable in the commencement of their career, of tracing error, and before they have run the extensive and severe gauntlet of gentleman farming, they are commonly so severely "lashed," that they too generally tire or faint by the way.

Thus agriculture is not only stripped of the talents, enterprise and capital of men, who, if they had been well informed, would have done honour to their newly adopted profession; but it is branded with being the cause of all the losses, crosses and mortifying disappointments, that may have happened to the gentleman while he was engaged in rural pursuits. In fact,

> "The farm is charg'd with ev'ry ill,
> Springing from whence, or where it will;"
> "That it brings ills enough, is true;
> Not all—then give the d——l his due."*

As Mr. Bordley says much of the evil arising from poaching the soil, also of the great advantages that may be derived from growing extensive crops of potatoes for fattening hogs, and speaks highly of the practice of plougning from and to plants, the gentleman in the commencement of his business is too commonly infatuated with Doctor Anderson's mode of planting and cultivating this root; for it is really plausible, and a great increase is promised. The Doctor says, the ground should be well prepared, and the manure hauled and dropped on the head lands. After the furrows have been formed three feet asunder for planting, to prevent the soil from being poached, he directs short rich manure to be carried by labourers in baskets, and spread in the bottom of the furrows, to supply nutriment for those roots which gather food for the plants. After this, the potato sets, weighing, if I recollect right, not less than two ounces each, are to be planted eighteen inches asunder, in the rows; and lest the bulbs which are to be formed on the fruit roots should be too much oppressed with a heavy covering of soil, he directs the furrows to be filled with long light manure, consisting principally of straw, and the soil to be spread so lightly over this covering of manure, that the straw may be seen peeping through the covering of mould. I

* These lines are taken from a poem written by a gentleman, after he had run the gauntlet of gentleman farming.

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do not recollect that the Doctor says that he ever planted potatoes in this way, and am disposed to believe that he never did, except in his garden, or he would have clearly seen that the expense necessarily arising from such a tedious and laborious process, would be entirely too great to admit the profitable introduction of his system of management on an extensive scale. However, be this as it may, it is certainly an ingenious plan, and if the Doctor had ordered the sets to be placed at nine, instead of eighteen inches asunder in the furrows, and said nothing of ploughing from and to the plants, it is probable that a very considerable product might be obtained in this way. But ploughing from and to the plants greatly injures the roots which nature has provided to gather nutriment for them, and unless these operations cease before the fruit roots can be injured, they are less or more cut off, of consequence the crop is curtailed, in proportion to the injury done to these roots. As it is not to be expected, that the gentleman, in the commencement of his business, can readily determine when the fruit roots are in danger, it is ten to one, but the crop be greatly injured from this cause alone. However, if this last evil should be avoided, theroots on which the plants depend for their principal support will certainly be out off, and the stubs of the roots left exposed to the injurious effects of the sun and air every time this truly inconsiderate operation is performed, consequently a great loss in the product will certainly occur; therefore we may rationally conclude, that the gentleman's potato crops, obtained through the medium of this very tedious and very expensive practice, will not be equal to the crops grown by the full bred farmer, with but little comparative labour, perplexity and expense.

The purchase of live stock seems to be the most difficult business the gentleman has to encounter. The knowledge of their value and disposition to fatten, is only to be obtained by practice and attentive observation; but this is not all, for when the farmer actually possesses this knowledge, it will often be found a difficult task to purchase such as will pay him a moderate price for the food consumed by them, before they are fit for market. This being the case, the whole of the profits arising from a farm otherwise well conducted, are readily sunk in a mistaken purchase of the live stock necessary to consume the hay, grass, &c. grown on the place. Even after they have been judiciously purchased, if the management of them be not well conducted, the loss on them may be very considerable.

It requires much less judgment to breed, rear, fatten and sell; but this is impracticable where lands sell high, except soiling be practised, and the gentleman either happens to procure excellent breeds at fair prices, or takes a peculiar pleasure in improving the valuable properties of his own stock. Breeding and rearing stock, is the principal means by which the farmer in our extensive back settlements can procure a sufficiency of money to answer his purposes. An extensive range outside of his cleared grounds, generally furnishes his stock with sufficient food until snow covers the ground; still he is but too seldom remunerated for the other provender con-

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sumed by them, however his peculiar situation compels him to rear stock, and drive them to the older settlements; also to sell them for much less money than it would cost the purchaser to rear them in the usual way. If this were not done, the buyer would find it more profitable to rear his own stock.

Here it may be proper to advise the gentleman, to be cautious how he engages in fattening cattle, &c. either on roots or grain; for unless superior management is practised, it too often terminates in a very serious loss.

Correct accounts are as necessary to the gentleman farmer as they are to the merchant. They determine the expense of growing each crop, also the profit or loss on each variety. This is of high import to the farmer, as it too frequently happens that some crops or animals are a perpetual sinking fund, when others might be readily introduced which would be profitable. Much oats are grown on the grounds which are not further distant than about thirty miles from Philadelphia. As this plant, like Indian corn is capable of contending with poverty, the cultivation of it has been continued on thin soils, although, if my calculations be correct, if an average price, together with the expense of hauling them to market be estimated, an average crop brings the cultivator considerably in debt. Now if this were known, it is presumed that the farmer would either abandon the practice, and grow more productive plants, or by a better system of management introduce more nutriment for his oat crop. Very fat cattle, and luxuriant crops are also too frequently obtained by expensive practices which are entirely inconsistent with profit. The knowledge of this would certainly induce the reflecting farmer, either to introduce a better system of management, or to abandon the practices.

Full bred farmers too frequently sustain considerable losses in this way: yet many of them become wealthy, for the profit arising on their own labour and that of their family, together with their general management and strict economy, greatly overbalance these losses: still, these errors should be rectified. I, therefore, advise every farmer, not excepting such as are barely capable of keeping accounts, so that they may be understood by themselves, to adopt this invaluable practice.

The profit of farming greatly depends on the economical management of working cattle, with the implements immediately connected with them. An account should be opened for teams, and charged with the cost of the horses and other working cattle; also the waggon, carts, ploughs and other instruments connected with them; likewise shoeing, and the grain, roots, hay, &c. consumed by them; and at the end of the year with a proper per centage or premium for the risk of their lives. Perhaps less than five per cent. which seems to be the usual premium, would cover this risk on all kinds of live stock, if a full supply of nutritive matter be provided for them, and proper care be taken of them. A sum equal to such depreciation in their value as may arise either from age or accident,

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should also be charged: likewise, the annual wear and tear of carts, ploughs and other instruments connected with the use of the teams, together with an average interest on this account, which being previously credited with the number of days the horses and oxen may have happened to work during the year, will determine the cost of a day's work done by one or more of them. The gentleman may rest assured that unless no more working cattle be kept than are absolutely necessary, and great economy be practised in the management of them, and the implements connected with them, the price of a day's work done by one or more of the horses or oxen, will so far exceed credibility with those who have not investigated this important subject, that I shall omit making the probable estimate, lest it might be supposed that it was not founded on facts that actually exist when the genuine principles of rural economy are not properly attended to in the whole of this complicated and expensive arrangement. Yet no rational objection can be made against the mode of calculation that has been recommended, for the gentleman's money, well secured by mortgage, will produce legal interest, without being subject to either drawback or *risk*. An account similar to that for the horses and working cattle, that is in every proper charge, will determine the expense and cost of the animals reared or bought in for sale. The account of teams for the ensuing year, will of course be charged with the present actual value of the horses and oxen, together with the present actual value of the implements connected with them.

The expense of each crop will be determined by charging it with the cost of cultivation, &c. Also, an average interest on the capital employed on it, together with a rent for the ground, equal to an annual interest, on the sum it cost per acre: this should be estimated by adding to the first cost of the farm, the cost of the necessary improvements made to place the buildings, fields, fences, &c. in a proper condition for farming. But after the farm has been put into proper order, an account should be opened for the general expenses of it, such as keeping the buildings, fences, &c. in order, or such other charges as cannot be readily placed to the debit of any particular crop, &c. and after charging an annual average on this account, the balance should be carried to the debit of profit and loss at the end of the year. The whole of the grass grounds for any one year, will require but one account, be the fields many or few. An account should also be opened for such implements of husbandry as are not connected with the teams, and their separate costs and repairs charged to it: also an annual average interest on the amount; likewise the wear and tear of the implements. After this has been done, and credit given for the actual value of the implements on hand, the balance should be carried to the debit of profit and loss.

Here, it may be proper to observe that the necessity of averaging the length of time for which interest ought to be paid on the dif-

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ferent accounts, naturally arises from the various expenditures originating at different distinct periods.

The expenses of a farmer's family greatly depend on their habits: some spend too little, and others too much. It is, therefore, obvious that the profit or loss of a farm cannot be fairly estimated, unless the articles procured from it for family use, be charged to the "household expenses," and the board of the workmen be charged to the farm, at a price covering, but not exceeding the full cost of it, including a reasonable sum for wear and tear of bedding, &c. also interest on the cost.

If regular double entry be pursued in farming accounts, they will be found excessively tedious, but this is useless. A few minutes in the evening, will suffice for entering in a daybook the transactions of the day. Less than one day will be found sufficient to arrange and enter in the leger the transactions of the month. If the names of the several accounts which may be concerned, (except personal, for these, with a few other items must be separately entered,) be written on the upper edge of a sheet of paper, so that the number of days and the cost of the work both of labourers and working cattle, may be regularly arranged in columns, in figures only, under the proper name or head to which the work belongs, when each column is summed up, the contents of each will determine the amount of debit and credit which belongs to each separate account, so far as either the labour of men or horses is concerned. The whole of the work done during the month, by the working cattle, should at this time be entered in one line, to the credit of teams. The work done by the labourers ought not to be placed to their credit until the end of the year, or so often as they may settle with the gentleman, which will be frequent, when hired by the month or day. Seed with some other articles will also require separate entries; but the whole of these will be found trivial. It is the frequent change from one field, and one work to another, that renders it tedious to keep farming accounts by regular double entry. A change in weather often compels a sudden change in the work. When one field is finished, the labourers, horses, &c. are sent to another, be the hour of day what it may. If the wind rises, and the people are sowing plaster or grass seeds, they must leave this for some other work. In short, it would be an endless piece of business to particularize the different causes that often divide and subdivide the hours of the day into various kinds of work to be done by labourers, horses, &c. The sheet of paper ought to be filed, lest any thing thereafter should occur to induce a suspicion of error.

Every gentleman farmer ought to keep a diary, in which the winds and weather should be registered, with the effects produced by them; this may be done to answer the farmer's agricultural purposes tolerably well without the aid of the thermometer or barometer, but far better with them. Without the assistance of the former he cannot well describe the climate in which he lives, either by

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conversation or writing. The latter shows that important changes in the weather are to be expected before we either see or feel that any change in the atmosphere has taken place: consequently this instrument is important, especially in hay time and harvest, and when seeds are to be sown.

The effects produced by insects, blight, &c. together with those arising from drought, storms, excess of rain, and from the practices pursued, should be entered in this book; likewise the time of sowing, planting, &c.; also the nativity of domesticated animals, as well as every other interesting occurrence or circumstance connected with agriculture. If this book be kept correctly, a reference to it will be frequently found invaluable. In fact, no man whose memory is not equal to a parish register, will ever understand farming without it; and the time required to keep it is but a few minutes in the evening of each day.

If the reader will take a retrospective view of what has been said of the gentleman's expensive preparation for the accommodation of his family; also, for farming, and the scanty product that is to be expected from his fields, extensive stock of cattle, &c. while he is running the gauntlet of gentleman farming, he will find every reason to believe, that an immense sum of money will be spent, and but little received in return, except the few dollars and cents occasionally gathered, and but too seldom honestly delivered, by his unfortunate market-man. The profits of the farm will be so far from paying any part of his family expenditures that they will fall very short of paying the board of those that labour on it, and furnish sufficient provision for the working cattle and other live stock kept on the place, If the gentleman lives in style, his expenses are infinitely greater than they would be in town. If he depend on the country butchers and bakers, the articles are generally very inferior and much higher priced than they are in town. The same happens (so far as price is concerned) if he depend on the farmers in his neighbourhood for butter, poultry, &c. If a servant be sent to procure these articles in town, his labour and that of the horse is lost, and the gentleman is but too frequently sadly cheated by him.

A gentleman living in the country not only entertains his company, but also their servants and horses. This, however, would not be considered an evil, if that company were generally such as he wished to see. But it too often happens, that the visiters form a medley that gives him more pain than pleasure. It is known that the gentleman's wine is good, and his table well supplied; and many who are fond of a jaunt into the country, and a good glass of wine, (although they never visited him in town,) take a ride (if they may be believed) for the express purpose of examining the gentleman's improvements; of which they commonly tell him much is every where said. As the wisest philosopher is not always insensible to well directed flattery, (although they have laboured hard to convince us that the contrary is true,) the visiter is po-

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litely entertained; and becomes so highly interested in the gentleman's very judicious and extensive improvements, that he cannot forbear calling frequently to observe the progress of them. If the gentleman be rich he will not feel the expense; but it is clear, that after he comes to understand the drift of too many of his visiters, he cannot help feeling, and that severely too, the great trouble and perplexity which is introduced by such a round of company: especially as by far too much of it happens on Sunday, when his servants are also traveling in pursuit of pleasure. This often makes it exceedingly difficult to muster sufficient assistance to get through the labours of a day, which preachers, and a few old fashioned people, tell us, ought to be devoted to rest and religion.

The gentleman's anxiety to have his buildings and pleasure grounds completed, and to have every obstacle to a perfect cultivation removed, too often induces him to keep many workmen and teams employed through the winter, which more than doubles the cost of this Herculean task. The days are short, and the season presents many serious obstacles to labour. The labourers commonly rise very late on a gentleman's farm, and for the most part idle much time away through the rest of the day. The gentleman seldom fails to observe this great loss of time, and takes such measures as seem best calculated to remove the evil, but he rarely succeeds. If he discharge his head man, or farmer, and pay very liberal wages to such as come highly recommended for their talents and industry; and some of them may really try to effect the change which the gentleman wishes, they find the labourers confirmed in the habit of idlenesss; also refractory, and determined not to be subdued by a hireling, whom they consider no better than themselves. As it too commonly happens that the gentleman has removed to the country for the express purpose of getting rid of the troubles and perplexities of the world, he seldom loves farming sufficiently to induce him to undertake this troublesome business himself: or the change might be readily effected by rising early in the morning, and attentively superintending his workmen through the day. His presence and intelligence would stimulate them to emulation and industry; and the business of the farm would progress regularly without any very apparent difficulty; as in common the gentleman possesses talents, enterprise and industry to effect this, or, indeed, a much more difficult task. But as he removed to the country to spend his days in calm and easy retirement, he has no idea of encountering a business which he considers exactly calculated to destroy his repose, and inconsistent with the rational pursuits of a gentleman; and so far as his views of farming are concerned, his conclusions are just; for unless a gentleman take great delight in agriculture, he could not readily engage in any business that a man of fortune and talents could pursue, which would not prove much less tiresome and perplexing to him than farming.

The winter is commonly a very solitary season in the country

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when the gentleman and his family do not take an active interest in the business done on the farm. It also generally happens when the buildings, pleasure grounds, &c. are extensive, that much remains to be finished during the ensuing spring, summer and fall. Therefore the yard round the house, garden, lawn, &c. remain greatly incommoded with large quantities of rude materials necessary to complete the work; this, with numerous unfinished designs, form the appearance of a wide unseemly waste, rather than the happy abode of rural felicity: consequently when the spring opens, the gentleman's family seem to be excluded from the enjoyment of it, for the dreary appearance of winter is protracted. As April is the common time when purchasers, as well as renters of land, take possession, the gloom that envelopes the gentleman's family may be still much more increased, if he happen to keep correct accounts. The settlement of his books at the end of his first year's apprenticeship to agriculture, will clearly convince him, that gentleman farming (when folly is attached to it) is a very serious and expensive piece of business. This fact is so very contrary to the opinion he entertained previously to trying it, that he must be possessed of uncommon fortitude or insensibility, if it, with the continued perplexity arising from his mismanagement, does not greatly reduce his usual vivacity. If this happen, it will naturally spread a general gloom through the family, as they cannot feel happy while they clearly observe he is otherwise.

It would be useless to describe more than the events of the first year of the gentleman's apprenticeship to farming, for notwithstanding he may be very prudent, and studiously avoid the errors he has committed so soon as they are known, and actually make many valuable improvements, still, as he does not take an active part in the business, and fails in all his ill judged attempts to correct the idleness and mismanagement which prevail among his labourers, after spending two, three, or perhaps more, years of his life in perpetual uneasiness, he returns to the city disgusted with agriculture; and clearly convinced that it is impossible for a gentleman to farm in this country without becoming a perfect slave, or sinking a great deal of money, besides subjecting himself and his family to perpetual inquietude.

However, if the gentleman possessed a handsome estate previously to his removing into the country, and left no unsettled concerns in town, he may yet do well, notwithstanding he has sunk a great deal of money, for he escapes the ruinous consequences which have happened to some who thought it most prudent to make a fair trial of what they had to expect from farming before they laid aside their concerns in town. This is, however, an egregious, and too often, a fatal error: therefore should be avoided by every gentleman who engages in agriculture with the same care as he would shun the certain road to ruin. For, if he may happen to succeed, still, it compels him to hazard, in the prudence and management of others, what may not only subject him to very serious

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losses, but may also beggar himself and family: besides blasting his well earned fame for prudence and punctuality, by an assignment of his property for the benefit of his creditors. This is certainly too much to confide in the hands of others; for, although they may be deemed both prudent and upright, still, how many have we seen entirely ruined by the unwarrantable conduct of those in whom they believed they had every rational reason to think they might safely confide.

A city opens innumerable avenues for ruinous speculation; and every note must be paid by three o'clock on the day it becomes due. Should speculation turn out unfavourably, and the speculator be involved beyond the prudent extent of his capital, if the broker or auctioneer do not advance the money, the note is protested. An early protest is certainly the best thing that could happen for all the parties concerned. Shame, however, or hope, too commonly stimulates the adventurer to go on, and, as he knows those sacrifices will disturb the repose of his friends in the country, they are secretly made; and, unless accident should disclose them, they are not known until no prudence is capable of warding off the fatal stab to the gentleman's fortune and reputation.

Some have expected to escape this, by being almost daily in town. They have, however, not only found themselves mistaken, but in the end, stripped of all they possessed, and themselves and families turned out on the world, nearly as naked as when they came into it. It is true the world is wide, and the gentleman's talents and industry, may yet maintain his family; but will he not see, and feel too, how very differently they are compelled to live, and that his pleasing prospect of an independent provision for his children, is blasted ?

Nothing but religion, founded on a firm belief in a happy futurity, can enable the sufferer to bear, with resignation, this sad reverse of fortune. It is true, a firm mind, aided by philosophical reflection, may enable him to bear it with manly fortitude; but as this points with no degree of certainty beyond the grave, and little but suffering is to be looked for, on this side of it, but little consolation can be obtained from it.

However, if no evil should happen, from risking his fortune and reputation on the prudence of others, and his concerns in the city should terminate in a large accession of property, even gold may be bought too dear. If the gentleman really loves farming, his mind is continually harassed, not only with the idleness, but also with the mismanagement, which take place on the farm while he is in town. Admitting he can afford to lose the money, still his best laid plans are frequently defeated from this cause alone; therefore, he may be aptly compared to an amphibious animal, which is formed to act on land or in the water, but yet not perfectly calculated for either.

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CHAPTER XLVIII.

Observations on British convertible husbandry, as practised in Norfolk, Suffolk and Scotland. The errors in this husbandry explained. On the threshing mills invented in Scotland. On the mistaken opinion, that as turnips, and various other green crops, do not perfect their seed generally on the soil where they are grown, they are ameliorating. It is proved that the useless expense attached to British husbandry, has formed a new era in the annals of agriculture; that it has placed the farmers in that country on the pension list, to an amount nearly equal to half the value of the crops grown by them.

I HAD seen nothing new from Great Britain on agriculture, for some years previously to my removal here, nor any thing since, but had been frequently told, that very great improvements in this science had, of late, been made; especially in Scotland, which seemed to be outstripping even England herself.

Since writing the foregoing part of this book, Sir John Sinclair's Systems of Scotch Husbandry has found its way here. On reading this work, with much care and attention, my disappointment has been astonishingly great. But little improvement appears, except in very expensive practices and institutions, exactly calculated to promote extravagant parade and show.

As the gentleman farmer in this country, has been too long taught to imitate Great Britain in his practice, and it is him I more especially mean to instruct by writing this book, it is considered proper to make some remarks on British husbandry, as it is now practised by the mammoth farmers, in the most highly improved parts of that country, and where it approaches nearer to what it ought to be, than it does any where else.*

In Scotland, Norfolk and a part of Suffolk, convertible husbandry is now generally practised: in Scotland, old grass grounds are but rarely seen or spoken of, except with the contempt so justly due to a practice bordering on barbarism.

Whether the farmers in Norfolk and Suffolk have been wise enough to banish this inconsiderate, and very injurious practice, (where population will admit a better,) or whether veneration for an ancient practice induce them still to retain a part of their old grass grounds, is unknown to me. This is, however, of but little consequence to my present purpose.

* This seems to be the more necessary, as a scarcity of books here compelled me to quote Mr. Young's Rural Economy, to illustrate my remarks on British husbandry: for as that book had been written some years ago, the reader might have considered a reference to it, not calculated to explain the expensive practices now prevailing in England.

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As convertible husbandry is unquestionably the most profitable that can be adopted in any country, where population will admit it to be practised, I shall confine my present remarks on the agriculture of Great Britain, to Scotland, Norfolk and Suffolk, alone.

In Scotland, the labour uselessly and very injuriously employed to cultivate the soil, is so great as to exceed credibility, if it had not been detailed by Sir John Sinclair, who, though he seems to admire the system of management, appears to wish, and in fact believe, that the labour might be greatly reduced.

In Suffolk, the labour is much less, but so ordered, as to be very injurious to the soil.

In Norfolk, the labour does not seem to be equal to that employed by Suffolk, except for the turnip crop.

The number of grass crops intervening between the cultivated crops, in the Suffolk system, is not mentioned by Sir John. It is, however, probable, that they do not exceed the number employed in the management of Scotland or Norfolk; of consequence, are insufficient either to favour luxuriant crops, or the improvement of the soil.

Britons appear to know but little, if any thing, of the value of a grass lay, when employed for a fallow crop. Hence it is, that in Scotland and Norfolk, and, as I believe, in Suffolk also, the crop, be it what it may, that commences the round of crops, generally, if not always, follows after some cultivated crop.

This seemingly entire ignorance of the immense importance of the judicious application of the grasses, in a course of cultivated crops, appears to have originated in the very erroneous value set upon old grass grounds. This caused the grasses to be but very seldom employed for the growth of cultivated crops, except a red clover lay, and as in the practice of Scotland, ray grass is generally sown with the clover, and the roots of this speargrass are not so readily subdued; especially in a clay soil and dripping climate, the propriety of sowing wheat on such a lay, still, however, called a clover lay, has been questioned by many of the cultivators there, who now seem to prefer sowing oats on it.

Such lays, however, or even a lay composed of speargrasses alone, provided the grounds have not been considerably consolidated by time, may be readily made to form as good a preparation for wheat, or any other small grain, as any known to us, if the sod be well turned by the plough, at a depth consistent with the enriching matters contained in and upon it, or that have been previously spread over it; and the grasses and weeds are properly subdued, in the way that has been directed in my book on Cultivation.

The great defect in British convertible husbandry, is a deficiency of grasses in their system of management, and commencing their round of crops on grounds where some cultivated crop had been just before previously grown, in place of commencing them on a grass lay, together with employing an excess of labour, which in place of doing good, inflicts serious injury on the crops, as well as

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on the soil. It is, however, in the practice of Scotland, that this excess of labour is most conspicuous.

Sir John tells us, "the process of fallowing, according to the Scotch system, is both laborious and expensive, but it is the *pivot* on which depends the proper cultivation of the clay lands in Scotland. The number of ploughings must be as many as *six* or *seven*. Rolling *repeatedly*, is also necessary to break the clods, in order that access may be had to the root weeds, mixed with the soil, and the lands must be harrowed for the purpose of bringing those weeds to the surface. There is reason, however, to believe, that after every solid clod has been crushed and reduced by the roller, that his object may be obtained by the scuffler, when the irons are bent. After harrowing, it is the most essential part of the process, to collect the weeds by *hand-picking*, the expense attending which, is *well bestowed*; some burn the roots that are gathered upon the field, and spread the ashes, whilst others gather them into a heap, frequently turning it over, till the weeds rot, and by mixing the whole with lime, an excellent compost is made, and an enemy is converted into a friend."* It would seem, however, that Sir John had better said, "thus a powerful friend, by being speedily consumed by fire, or more slowly reduced by the corrosive action of lime, is rendered incapable of doing much good."

This gentleman also says, "the grubber, known by the name of the cultivator,† is a farming implement, of late much improved. It turns up couch grass, or other noxious weeds, whose roots may be turned down by ploughing, out of the reach of the common harrow. In this case, therefore, recourse is had to the grubber, which effectually raises every thing to the surface. When this object is obtained, harrowing and gathering is again carefully employed. In all cases it requires four horses, but except when much *rough sod* is on the field, or an uncommon quantity of couch grass, only a steady and attentive driver is required, and never more beside the driver and a boy, with a plough staff in his hand, to put away any thing that is likely to occasion any interruption in the work. This implement costs from eight pounds to eight guineas;"‡ or from thirty-five to fifty-four dollars.

This costly instrument worked at great expense, by four horses, one man, and sometimes a boy, followed by harrows, and a multitude of labourers, cannot otherwise be considered than a disgrace to common sense; especially if the destruction effected by it, and those following after it, be duly appreciated. If it had been invented and used by the small farmers, as they are now called, Mr. Young might, with some appearance of propriety, have called them "the most ignorant set of people in the world." The invention and use of this destructive instrument, however, belong to the mammoth

* See his System of Scotch Husbandry, vol. i. pages 235, 236.

† Tools of the same description, and used for the same purposes, are called by different names, in different parts of Britain.

‡ See Appendix, vol. ii. page 163.

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farmers, as does that of many others, quite as much opposed to the object of farming and which, if time and room would permit, ought to be exposed.

When, however, it is generally known, that animal and vegetable matters alone, furnish food for plants, and farmers become better acquainted with the simple means, by which the grasses and weeds, injurious to their crops, may be readily subdued, and rendered, in proportion to quantity and quality, as nutritive food for plants, as any other vegetation grown on their grounds, they will greatly wonder, how it could happen that the enlightened cultivators in Britain, were so egregiously mistaken, as to employ with very great labour and expense, various processes, and different costly implements, constructed with fangs, &c. calculated for the express purpose of dragging up to the surface of the soil, far the greater part of the living and dead vegetation contained in it, which had not sunk so far into decay, as to elude the grasp of their destrustive fangs, for the express purpose of burning, or otherwise nearly destroying the nutritious matters contained in it.

Such, however, is the present practice of Scotland and Suffolk. Even Sir John himself tells us, the grubber effectually raises every thing to the surface; now as this cannot be doubted, it is evident, that it raises not only "couch grass, root weeds," and the vegetation contained in what this gentleman calls a "rough sod," all of which, if properly used, furnish valuable food for plants, but also every kind of vegetation, whether it be rough or smooth, which has not sunk so far into decay, as to elude its destructive grasp.

Much lime is used in Scotland, and it would appear, that in most instances, where the soil is rich enough without the use of dung to produce a good crop of wheat, the latter is not applied. It would seem, however, that it generally happens, that the naked fallow for wheat must be dunged, or if not, that dung is applied for some other crop in the round: therefore, as the cattle who made the dung, were fed and littered with the produce of the land, the seed of the couch grass, root weeds, &c. are introduced in it, as if sown to produce another crop of them. As ill weeds grow apace, ample provision is made for renewing the same inconsiderate and laborious task, when the next round of crop commences. Thus, a very laborious and ill judged system of husbandry, creates and perpetuates an abundance of useless and very injurious work for itself.

I have before pointed out how the preparation and cultivation of a whole and extensive round of crops may be obtained, with as little, or perhaps less labour, than what is called the improved system of husbandry in Scotland employs, in executing a naked fallow sown in wheat, and with by far greater advantage to the crops and the soil; still, as it is very difficult to convince those who have been long accustomed to bestow much useless and very injurious labour in subduing weeds, that a great deal less will effect that purpose much better, I beg leave to observe, that some amphibious animals can live very long under the water, but if confined in this situation

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too long, they invariably die, if not admitted to approach near enough to the surface, to obtain a supply of fresh air from the atmosphere. The same happens to hardy root weeds, for though many of them can live long, while every part of them is closely buried under the soil, there are none of them which do not eventually die, if, while they should exercise the powers of vegetation freely, they are not admitted, but for a very short time, to approach near enough to the surface, to obtain a sufficient supply of fresh atmospherical air. How they are thus more readily subdued by very cheap, expeditious, and simple means, has been also already clearly explained. Here, however, I beg leave to remark, that the best formed plans may be defeated, if they be not properly executed; thus if the hoes in the hoe harrows, by which, agreeably to my simple system, the soil is principally prepared, and the crops cultivated, be not kept sufficiciently sharp, apart, or it may be the whole of the tops of the hardy grasses and root weeds, will be only mangled, in place of being smoothly and effectually cut off within the surface of the soil. In this case the tined harrow, in place of covering the wounded plant closely within the earth by the soil above it, will drag its crippled, but still living leaves and branches to the surface, so as they may have free access to the air; of consequence, if the plant be hardy, it will live, notwithstanding the top may have been much mutilated.

Although many plants will long survive, if they be frequently mowed off close to the ground, there are none that can live long, if after the roots of the plant have been reversed by the plough, the new growing tops be regularly cut off by a well directed cultivation, a little within the surface of the soil, and the part of the plant remaining within the ground be closely covered by the soil above it.* Why then should the cultivators of the soil expend so much labour in the destruction of the hardy grasses and weeds, when with far less they might be subdued, and profitably employed as food for plants.

Sir John tells us, "nothing but the deepest conviction of the advantages to be derived from the operation, could induce such multitudes of skilful, intelligent farmers, to incur the numerous and heavy charges attending on the summer fallowing process." It is evident, however, that the expense must depend upon the amount of the rent, the number of ploughings, &c. and the value of the manure applied. Indeed the crop of wheat succeeding the fallow, must pay the rent and expenses of two years; of the amount of which the following calculations will give some idea.

* When plants are cut off by the ground, the sap dries on the wound. The air has access to the stubs, of consequence the new shoots are vigorous: especially as the root maintains its native position in the earth. But when the plant has been reversed by the plough, and the new tops arising from it are regularly cut off, and the root kept closely covered by the soil above it, great debility takes place, a powerful fermentation is also excited, and the plant, be it what it may, sooner or later dies, if the cultivation be judiciously conducted.

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	per Scotch acre.	per Eng. acre.
First six ploughings, harrowings, &c.	£4 0 0	£3 3 0
Secondly, for 2 years' rent, at 3*l.* per ann. Scotch, or 2*l.* 7*s.* 3*d.* per English acre,	6 0 0	4 14 6
	£10 0 0	£7 17 6

Mr. Summer of Gilchristian, however, estimates, that including time, as well as rent and labour, the expense cannot be less than 15*l.* Scotch, or 11*l.* 16*s.* English, $52 44 cents; nay 20*l.* or $70 and upwards have been so expended.*

It is evident from this statement, that an average crop, after adding the expense of harvesting, threshing, and marketing, would not pay any thing like the expense, when wheat sold at a fair average price.

What a great loss both in rent and labour must there then be, in what Sir John calls the improved system of husbandry in Scotland! especially if dung commonly applied for a wheat crop in Scotland had been estimated by this gentleman at the price it costs when made on the farm.

This very great loss both in rent and labour is still more especially inexcusable, as this gentleman tells us, that many of the Scotch cultivators travel in quest of agricultural improvement. It would appear, however, that in this instance they have traveled to but very little purpose: as in the improved parts of Suffolk, for between twenty and thirty years previously to the publication of his book on the Systems of Scotch Husbandry, a fallow crop, and also a crop of small grain following it, had been both obtained with but little more, if as much labour in the preparation of the soil, as is employed in what is called the improved system of Scotch husbandry for a single crop of wheat, and without sinking one year's rent of the land, notwithstanding the soil in Suffolk seems to be full as retentive of moisture, and quite, if not more difficult to manage in a wet time. But I trust it will be presently shown, that the extra labour employed in Suffolk to cultivate the ground, is not only useless, but also highly injurious to the crops and the soil.

Before this is done, however, it may be useful to make some remarks on the great threshing mill invented in Scotland: especially as it seems to be of the utmost consequence in the management of the mammoth farmers in that country. From hence it would appear that the use of it has spread with great rapidity through England.

We are told by Sir John, that it costs two hundred pounds when it is made to be worked by six horses. It was, however, soon discovered that when the mill was worked by horses, the labour, added to that done on the farm, "proved destructive to them."† To prevent this injury, oxen have been kept by some cultivators for the use of the threshing mill.‡ Others, to avoid this great increased

* See vol. i. pages 237, 238. † Idem, page 83. ‡ Idem, page 83.

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expense, have encountered the task of erecting those machines to be driven either by water, steam or wind. The expense of a threshing mill to be driven by the wind, is two hundred and fifty pounds. But as wind often fails, and the stream of water on the farm is not always sufficient, especially when most wanted, in many instances it has been considered best to annex a horse power also to mills of this description. In this case, the additional expense of one hundred and twenty pounds is incurred, making in the whole six hundred and seventy pounds, Scotch, or about two thousand, two hundred and fifty dollars.

The interest on this considerable sum together with the necessary repairs and interest on the amount, must act as a heavy tax; especially, if it be considered that at some future day, not very far distant, the machinery will be worn out, as waggons, carts, ploughs, &c. are, and if the use of it be perpetuated, it must be again erected.

It is stated, that "The aggregate advantage derived from well constructed threshing mills, wrought by water, and under proper management, when compared with the old mode of threshing, *will* be eight per cent. on the corn threshed, including labour alone, but without making any allowance for the money *sunk* in erecting the mill, or repairing the machinery."* But, here I would ask, if only eight per cent. is said to be the advantage, when water, on which no expense is rated, is employed, what is to be expected, when the expense is greatly increased by using horses?

Now it is exceedingly strange, that in all the calculations I have seen, of the money to be saved by this instrument, no estimate whatever has been made, either of the interest, or cost of repairs, or the money, and a large sum it is, that must be eventually sunk when the machinery is worn out. When on the other hand, calculations, in plenty, have been made of considerable advantages to be obtained by the cleaner threshing, &c. when done by the mill. Although it is as evident as any other thing can be, that by no instrument can grain of every description, be cleaner or better threshed than by the flail: also, that the small farmer, as he is now called, either by doing the business himself, when but little else was to be done, or by assisting in it or superintending it, generally found but little difficulty in getting his grain threshed well, and in due time by this instrument.

It would seem, however, that if the only just mode of calculating fairly the expense on both sides of the question had been pursued, that it would have been found, as some gentlemen well acquainted with the threshing mill have asserted, that getting out grain by it costs more than when it is done by the flail; especially in a country where only the one-twenty-fifth part is paid for threshing with the latter instrument. Certain it is, that Sir John allows that without care and good management, wheat may be badly threshed by the

* See vol. i. page 96.

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mill, and he seems to think that unless in harvesting, the straw has been laid straight, it should be passed twice through the mill.

The true state of the case seems to be simply this, that on very extensive farms where great quantities of grain are of course grown, unless the ground be too poor to yield tolerable crops, the time consumed in threshing so much of it by the flail, and "the loss by inattention was so *insufferable* that the farmer was *afraid to go from home for eight months* in the year during which the *threshing lasted*;" it is also said by Sir John, that if in the large farms, hand labour were to be used for separating the corn from the straw, a farmer's whole attention would be taken up by barn work, otherwise the work would be imperfectly executed, whilst *much pilfering* would be going on, unless he was constantly on the watch."*

Here this gentleman, who in no case appears to wish to disguise facts, lets the cat out of the bag. These seem to be the principal reasons why the agriculture of Scotland has been saddled with the enormous expense of the very costly threshing mill. In fact, every thing is done to such very great disadvantage on a very large farm, that this circumstance alone appears to compel the cultivator to avoid perpetual inquietude by too frequently deviating very widely from the genuine rules of rural economy, in his practice.

We are told by Sir John, that "a small machine has been contrived on Meikle's principles, (the inventer of the larger one,) which may be purchased as low as eight pounds, and may be driven by two men, though a small horse would be a better power to apply. An account of this machine, and an engraving of it, extracted from the Farmer's Magazine, will be found in the Appendix, No. 20. There is no doubt of its being perfectly adequate to the threshing of the crops of small farmers; and is more likely to be adopted in foreign countries than the larger machine."†

From this, we may readily infer, that Sir John thought of the agriculture of foreign countries, and how highly he estimated that of his own. The effects, however, which the late general peace had on the agricultural interests of Great Britain, ought to have since then convinced him that foreign countries had at least acted wisely, by not introducing into their agricultural system of management such very costly implements, and highly injurious and expensive practices as had been done in Britain.

The small threshing machine, however, might be highly important to the agriculture of this country; especially if it may be readily so altered as to thresh about one hundred bushels of wheat per day when driven by one horse. This seems to be intimated in the second volume of Sir John's System of Scotch Husbandry: see the Appendix. It should, however, be observed, that some have made objections to it, as well as to the larger one. But whether those objections are well or ill founded, is unknown to me, further than that the large mill will be found by far too costly to

* See vol. i. pages 92, 93. † Idem, pages 103, 104.

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be employed where an economical system of agriculture prevails, even should it be much more perfect than it is represented to be by those who esteem it most highly.

In every country, and in every age, gentlemen of fortune and leisure have had their hobby horse. Agriculture has been the hobby of the present age. When this nag is driven by the small but intelligent practical farmer, who has been accustomed to employ strict economy in equipping, and caution in driving it, observation clearly proves it to be the most durable and useful nag in the world.

But when mounted by the gentleman, who but too commonly employs great expense in equipping and managing his hobby, and, Jehu-like, drives furiously, the nag, not accustomed to be thus treated and driven, becomes weak and debilitated, and notwithstanding great bounties may be offered, and the quackery of government employed to relieve and restore the hobby to its native energy, it eventually dies, and it cannot prosper but in its own element.

Every thing thrives best in *its own element*. Thus, while poultry fequently perish in, the very costly, extensive, and seemingly convenient and well formed establishments made for them by the gentleman, they thrive, and produce abundantly, in the apparently uncomfortable, smoky, and but too often filthy, clay cabin of an indigent Irishman.

A *minute economy*, very different from that which gentlemen have been accustomed to practice, and which is very difficult to be either learned or employed by men who have generally had at command a plenty of money, is the only *element* in which agriculture can permanently flourish. We might have long since seen and known this full well. By observing that a multitude of gentlemen in this country (where the agriculturist is not bolstered up by bounties) had, after sinking a great deal of money, abandoned farming merely because they did not understand, or neglected to practice, in the management of their business, the *minutiæ of economy*, so closely connected with the well being of it.

It is evident, however, that many of those gentlemen would have far better succeeded if they had not been led by the false glare of British agriculture into many expensive practices which were entirely inconsistent with the *economy of farming*.

To cast further light on the management of British convertible husbandry, I beg leave to insert some extracts taken from a report made by A. Young, of the management of clay or retentive soils in Suffolk: particularly as it may convince the reader, that the cultivation of clay or retentive soils may be much more profitably managed than is done in Scotland,* notwithstanding the Suffolk ma-

* This seems to be the more necessary, for notwithstanding much has been both said and written against naked fallow, to my utter astonishment I find they still prevail even among the farmers in Scotland, who no question may be justly ranked among the most enlightened cultivators in Britain.

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nagement is also too expensive, and equally as destructive to the vegetable matters contained in the grounds.

Mr. Young observes, that "In the Suffolk report there are many details of an improvement in the tillage considered in that country as of the greatest importance, and which has been extensively practised for above twenty years. The soil of the district where this practice prevails, is a wet loam, on a clay bottom, too heavy for turnips, however well drained.* The old system of the country was a plan, common throughout the kingdom, to give one spring ploughing for peas and beans, and two or three for barley or oats. The uncertainty of the weather in the spring rendered this system of tillage the most difficult and perplexing part of the business of a wet land farmer; drying north-east winds left a surface of hard clods, and rain turned it to mud; much expense, late spring sowing, and bad crops, were often the consequence; but the new system introduced, has removed every evil, and placed the farmers in great security.

"The management they have adopted is this, while the land is yet dry in autumn, the fields are carefully ploughed into ridges exactly of a breadth which suits the various implements to be employed in the spring, such as harrows, scufflers, scarifiers, and drill machines, all adapted to one given breadth, so that no horse when drawing any of them may ever set a foot on the ridges, but move solely in the furrow.† The governing principle of this is, the winter's frost leaves the surface in the finest possible order for seeds, loose, and friable, dry and porous. In this state, if rain falls on it, the soil dries again, and recovers its porosity, whereas if rain falls at this season of the fresh ploughed land, the tendency is to plaster it, and it does not again become porous. If such a fresh friable surface be ploughed down, nothing equal to it, for the seed of a crop, is to be expected one year in twenty; whereas by retaining the soil, thus ameliorated by frosts on the surface, the spring crops may be sown sometimes in the beginning of February, and in other seasons about the middle or end of that month, or perhaps the beginning of March, and in much better order for a crop than according to the old system, at the end of April, or throughout the month of May,

* That is as I suppose agreeably to the prevailing fashion under drained. This, however, seems to have been found insufficient, therefore recourse was had to ridging, the only rational remedy where the excess of moisture does not arise from spouts or springs. In nothing is the inconsiderate and enormous expense, which folly has attached to British husbandry, more conspicuous than in under draining a retentive soil. Common sense and observation, if they had been consulted before this Herculean task became fashionable, would have determined that but little water could find its way through a clay soil, which holds moisture nearly as well as a cup, into the under drains.

† Mr. Young here notes, that "It is proper to state a distinction between scufflers and scarifiers. The scuffler is an instrument with flat triangular cutters merely to cut the weeds, and they are afterwards raked up by harrows. The scarifier on the other hand, has bent coulters, tears up the couch grass and other root weeds, and brings them to the surface. It has various other names, tormentor, cultivator, &c."

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though with an additional expense of perhaps thirty shillings per acre.* If there are weeds in the field, a scuffler is made use of first, followed by harrows, then by the drill machines, for in that part of Suffolk the corn is generally drilled; and lastly, a light harrowing to finish the tillage; but sometimes the drill goes on at once, followed only by light harrowing. The success which has attended this practice has been so decided, that all the best farmers have for some time past adopted it.

"Such was the state of this husbandry on the strong lands of Suffolk down to the year 1804. The President of the Board of Agriculture being informed that the practice had rather declined, he requested John Mosely, Esq. of Tofts, near Brandon, to ascertain that point; and in April, 1813, he had the pleasure of receiving a letter from that gentleman, informing him that the use of the scarifier, instead of the plough, in the spring, is more predominating, instead of less so."†

Notwithstanding a part of the Suffolk system of husbandry is good, it is evident, the most that can be generally effected by it, is too keep up the present fertility of the soil by the application of much enriching manure. Improvement, therefore, is not to be expected, except in cases where unusual exertions are made to effect this purpose; and even in that case it must progress very slowly, unless much enriching manure is purchased

The reason is obvious: there can be but few, if any, soils which are capable of withstanding having nearly all the vegetation (except that part of it which has sunk so far into decay as to elude the fangs of the scarifier, or tormentor, of the soil) dragged up to the surface, carefully collected, picked up by hand, and either consumed by fire, or greatly wasted by decomposition and the action of lime.

In fact, it would appear, that any cultivator, if he possessed but a very moderate share of native talents, and exercised his reason on a fact so very obvious, and had been previously taught that animal and vegetable matters alone furnished food for plants, might have seen that no system of management calculated to destroy such great quantities of vegetable substances could be proper, be the advantages resulting from it in other respects what they may.

It is obvious, however, that neither the scarifier nor any other instrument calculated to drag out the grasses and weeds, can so effectually subdue them as a well directed fermentation. For in no case can it be otherwise than that some of those grasses and weeds, or parts of them at least, remain unseen, and covered up in the soil, where they will grow.

* Mr. Young does not say how this additional expense of thirty shillings, or six dollars sixty-seven cents per acre arises. It seems probable, however, from the use of the scarifier or tormentor, together with harrows and multitudes of hand pickers of weeds, &c. following it. If so, it is the more to be regretted, that so much labour should be expended to do harm in place of good.

† See Sir J. Sinclair's Systems of Scotch Husbandry, Appendix, pages 66, 67.

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But here I would ask, should we degrade our reasoning faculties so much (especially in a country where every citizen who can, and will work, may be profitably employed) as to spread a considerable proportion of our population over our fields to gather carefully by the tedious process of hand picking, the grasses and weeds dragged up to the surface by great labour and expense, when the most simple and most expeditious tools employed by us, and aided by a well directed fermentation, are exactly calculated to subdue, save, and judiciously apply this hardy, but invaluable vegetation, to the growth of the crops and improvement of the soil? No, my countrymen, let this destructive process remain the exclusive privilege of those who invented it: to wit, the mammoth farmers of Britain, who have been compelled, from the effects produced by their truly expensive system "of economical management," to publicly confess to the world, that the "foreign agriculturist is *really* so much against the English farmer that the latter *cannot* bring the produce of *his own soil*, and in *his own market*, at *one-half* the price at which *even a Frenchman* can supply us."

Now why did the mammoth farmers (or, as Sir John calls them, "*commercial* farmers who *speculate boldly* in lands as in *other mercantile transactions*") make this degrading confession? The reason is obvious: it was done to place the agriculture of Great Britain, now no longer able to maintain itself, on the list of pensioners. Thus has Mr. Young's system of "economical management" converted not only all the farmers, great and small, into paupers, but also all the men, women and children employed by them.

That the agriculture of Great Britain has been placed in this degrading situation, is evident; and, if we may believe the arguments used by the mammoth farmers to effect this purpose, it is equally evident, that it requires half the amount of all the products of the soil* to put them on an equal footing in their own market "even with a French agriculturist."

Now there can be but few men in their sober senses who will readily believe that the extra taxes introduced by the late war, bore any proportion to the amount of one-half of the products of the soil: consequently the balance, and a very large one it is, must have originated in the extra expence introduced by Mr. Young's mistaken system of "economical management," formed, as he seems *to boast, by his very superior talents*, "on untrodden ground." But to return to the scarifier or tormentor of the soil. It has so happened, that philosophers, chemists and farmers have too generally expected much food for plants from various substances which either contained too little to be perceptibly useful to agriculture, or none at all.

This has caused them to estimate animal and vegetable matters, which are the only food on which plants can live, so little, that

* No more of this produce, however, than is actually sold, or paid away in lieu of money, should form a part of this estimate.

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they have but too seldom hesitated to burn, or otherwise destroy them, when they were opposed to their favourite plans. When nature and reason, however, have been harmonized in the practice of husbandry, these absurd and destructive practices will cease, and the great value of animal and vegetable matters will then clearly appear. Fixed principles of cultivation will also be established, by which these matters will be carefully employed, when it can be done, in the soils where they are found growing, whether they be hardy or otherwise, rough or smooth; also, collected by every rational means, and so saved, applied, and managed, that nothing will be lost which human ingenuity can save.

In a soil so wet as Mr. Young represents a part of Suffolk to be, the labour, except that performed by the scarifier, and the gathering and destroying the vegetation dragged up by it, seems to be executed with skill and despatch. "The fields are carefully ploughed into ridges exactly of the breadth which suits the various instruments to be employed, such as harrows, scarifiers, scuffiers, and drill machines, all adapted to one given breadth, so that no horse sets a foot on the ridge, but moves solely in the furrow."

Hence it would appear, that the rudiments of mathematical precision have been already attained. These properly improved, would lead us to the knowledge of the proper depths and distances at which seeds of every description should be placed in the soil; also, to invent simple, cheap instruments, by which this purpose may be effected, and likewise to cultivate the plants properly and with despatch.

Nothing can be more evident than if the vegetation dragged up to the surface of the ground, by the scarifiers, and there destroyed, or very much wasted, had been permitted to remain, after its roots had been reversed by the plough, where nature had caused it to grow, and its vegetative powers subdued by the ready and effectual means which have been pointed out, that notwithstanding nothing like the same quantity of it could generally have obtained, as prevails in a grass lay well stored with the roots of the grasses, the adhesive soil would have had its parts divided and expanded to a certain extent by it. The moisture would have also been filtered off, in due proportion to the divisions made in the soil by it. The plants grown on the grounds would likewise have been fed and invigorated, and the soil improved, in proportion to the substances which were dragged up and destroyed on the surface of the field, by the injudicious mode of cultivation now practised in Suffolk and Scotland.

It would appear, however, that Britons have not yet learned to value vegetation in all the different shapes and forms in which it appears in their fields in due proportion to the food for plants contained in it; though in Suffolk and in some other parts, the tools are in common use, which would readily subdue and bring into active employment the vegetation which is now uselessly devoted to destruction there.

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Neither have those cultivators whom we have been urged to imitate in our practice, any just ideas of the great value of a speargrass lay. If they had, they would certainly employ such lays, where convertible husbandry prevailed, for every fallow crop grown by them. Nothing can be more obvious where they have been employed, than that they form the best preparation that has yet been discovered. Even a turnip crop will grow much more luxuriantly on a grass lay, than any where else, if the grounds have been properly prepared for that plant. In fact, I do not know a single plant that will not prosper better on a grass lay than any where else. The many gardens originally made on grounds of this description, in this country, demonstrate this very interesting fact. In a system of convertible husbandry, however, where a sufficiency of grass intervenes, beans will be found not only a more lenient fallow crop than turnips, but also much more valuable, as will appear in a statement heretofore made in this book, to convince the gentleman farmer, that maize is a far more profitable fallow crop than turnips, or even than the horsebean grown in England.

I did not at that time know that the bean plant afforded such valuable dry fodder. I, therefore, beg leave to observe, that if this had been duly considered, the advantage to be derived from growing beans in place of turnips, for a fallow crop, would have appeared still more considerable.

Sir John Sinclair informs us that the straw of the bean is much employed for feeding horses in Scotland, and that "when it is well harvested, it is little inferior to hay."* The fodder would be still much better, and the crop earlier harvested, if the plant were cut off by the roots, as soon as the milk in the bean disappeared, and set up in compact well formed heaps, in the same way as has been recommended for harvesting maize.

We have been informed that the Heliogoland bean, of late introduced into England, "produces, without extra manure, from sixty-four to eighty bushels per acre. In one instance, one bushel and a half sown on half an acre of poor clay land, without manure, yielded fifty-two bushels and a half, Winchester measure. Some stalks had one hundred and forty-two pods on each of them. They are said to be infinitely superior in point of productiveness and quality, to any other ever introduced into England. That the merit of this bean consists in its perfect fulness of form, and thinness of skin, and ripening much sooner than the common sorts. They are short in the straw, the pods grow in bunches, commencing near to the ground."

"Such a bean would be very valuable to be grown by the circumscribed farmer, in drills, on his thinner soils, to prepare them for small grain; they would produce a more valuable crop on either clay or sandy soils, provided the grounds were well covered with the tops of the grasses, and well stored with their roots.† A much

* See System s of Scotch Husb. vol. i. page 78.

† Red clover will effect such vegetation on a thin soil, if gypsum be employed, and act as it commonly does.

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larger crop, however, would be obtained by a good coat of manure spread over the lay, previously to ploughing it for the growth of the plant. There can be no question but beans require less food than maize, consequently, that they are less exhausting. This fact was clearly seen in my mixed crop of maize and beans, as the reader may observe by turning to a description of it. There can be but little doubt that the horsebean delights in a clay soil. Practice, however, in our gardens, seems to determine, that it will grow luxuriantly in any soil, be the texture of it what it may, if sufficient food be provided for it; and there can be but little doubt, that a plant which requires no more food than the bean, will be able to produce a tolerable crop, in such a lay as has been above described, without the aid of farm yard manure. The farmer, however, who has the capital to keep a stock of cattle in proportion to the soil cultivated by him, should employ enriching manure, and in plenty, too, for all the fallow crops grown by him.

Sir J. Sinclair does not mention the course of crops in Suffolk; there can be but little doubt, however, that a deficiency of grass prevails there, as well as in Scotland and Norfolk.

This gentleman informs us that the famous Norfolk system, is first, turnips; second, barley; third, clover; fourth, wheat. He says, "this course is no longer so generally recommended: it is considered prejudicial to the landlord; and on a lease of twenty-one years, if constantly persevered in, it would not be found profitable to the tenant. Half the farm is annually in white straw crops, which, from the frequency of the repetition, would not be productive; besides which, the number of sheep and cattle kept under this system, is comparatively trifling. It can hardly be questioned, that without a plentiful supply of extra manure, it will fail."

Few subjects are more highly important than the one I now mean to discuss, previously to my making further remarks on the Norfolk practice: I, therefore, beg the reader's serious attention. He may ere now have been led to believe, as my theories are frequently so much opposed to those which generally prevail, that I wish to be singular. Nothing, however, could well be more erroneous; for lest too marked an opposition to established customs, practices and opinions, should create an injurious prejudice against my book, and of course, cause my labours to be useless and abortive, I have endeavoured not to deviate further from the beaten track than appeared to be absolutely necessary. Hence it is, that little has heretofore been said of the marked exhausting property of the turnip, or of the generally but erroneously prevailing opinion, that the exhausting properties of plants, in most, if not in all cases, depend on whether they do, or do not, form their seed previously to being gathered or removed from the land where they grew: consequently, green crops in general, are called ameliorating, although some of these crops seem to exhaust the soil more than wheat. Emboldened, however, from what Colonel Taylor and Sir John Sinclair say

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of the turnip, I will make some observations on the nature and properties of it: also on the cabbage and the different roots commonly cultivated to be fed to live stock.

Sir John says, "The farmers *generally* think potatoes the least exhausting, therefore, cultivate them in preference to turnips." No variety of the potato known to me, produces much seed on its vines. That which I grow, is earlier than some other sorts, but by no means of the earliest kind. It puts out a flowering bud, but before the least appearance of a flower is seen, nature loosens the grasp of the bud from the vine, and it prematurely falls to the ground: of consequence, no seed is formed; and this seems to be generally the case with the earlier varieties.

The cabbage and all the roots commonly grown by us, except some varieties of the potato, form seeds, and if I recollect right, in plenty; but, in general, not until the year succeeding that of their being planted or sown. It should, however, never be forgotten, especially when we mean to investigate the exhausting properties of either one, or more of them, that notwithstanding they do not generally form their seed the first year, they attain their full growth, and gather from the soil, prepare and store up in their cells and vessels, the rich matter by which the seeds are formed and matured. It, therefore, seems reasonable to conclude, that if the plant be left where it grew, to form its seed the succeeding year, that the soil will be but little more exhausted than it would have been, if it had been removed before its seed was formed; as nothing can be more evident than by far the greater part, at least, of the matters by which the seed is formed, were gathered and stored up in the cells and vessels of the plant the preceding year.

If my memory be correct, it was said as far back as in the writings of J. Tull, that the turnip is a "cormorant plant," if it be suffered to form its seed on the land where it grows. Throughout my practice and observation, however, it has never failed to be a voracious "cormorant," and the difference, it would appear can be but little, whether it is, or is not, suffered to form its seeds on the land where it grows.

In fact, it may readily be proved to be a great exhauster of the soil. Wheat is justly marked among the exhausting crops, yet it will grow and pay the farmer for cultivating it, at least in this country, where the agriculturists have not been placed on the pension list, on poor ground, where he could not obtain a turnip crop that would pay the expense of gathering and securing it alone, by the usual means employed in the cultivation of that plant without manure.

My practice in growing green crops for feeding cattle, has been confined principally to the potato and turnip. I do not, therefore, presume to make any further observations on the exhausting properties of the other roots or of the cabbage, commonly cultivated for this purpose, than that I fully believe, that most if not all of them may be justly considered quite as exhausting, and I believe more

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so than wheat,* whether they be or be not suffered to form their seed where they grow, as it is evident, that in either case, the rich matter by which the seeds are formed, is gathered, prepared, and stored up in the cells and vessels of the fruit of the plants, while they are attaining their growth.

Sir John, however, seems to think that two white straw crops, following so closely together, is the cause of the evils arising in the Norfolk system. But the great faults in this system are, first, the exhausting properties of the turnip; secondly, too few grass crops; thirdly, ploughing but four inches deep. This depth is preserved from an idea that a "pan," as it is there called, is formed underneath the furrow slice. It may be, that by turning the furrow to the same depth, every time the ground is ploughed, the pores in the earth underneath it, are closed by the smaller particles of animal and vegetable matters existing on or near the surface of the soil, previously to its being ploughed. If this should form a "pan," by which the rains are more or less prevented from sinking deep into the soil, the moisture is confined so near to the surface, that it must be soon exhaled. The same cause which prevents the moisture from sinking, will also prevent that below the "pan," from rising upwards in a dry time; consequently the "pan," so far as moisture be concerned, can do no good, but may effect serious injury. In other respects, it is certainly very injurious, for notwithstanding reasons have been assigned why a poor soil ought not to be ploughed more than four inches deep, when but few vegetable substances exist either upon or within it, and enriching manure cannot be applied, it is as evident as almost any other thing can be, that as the fertility of a soil increases, it should be regularly deeper ploughed, in due proportion to the enriching matters already in or upon it, or the dung that may be applied, until a depth of eight or nine inches *at least* is obtained. The deeper animal and vegetable matters may be safely buried under the soil, the less of the volatile parts of those matters will evaporate. More moisture as well as a greater extent of pasture for the roots of the plants will be also secured by ploughing deep.

In fact, though no person can be more opposed to deep ploughing in a poor soil, than myself, I am clearly convinced that no depth of ploughing which can be expeditiously effected, at a moderate expense, can well be too deep for fallow crops, provided it does not extend deeper than nature or art has well enriched the soil.

Sir John Sinclair, after describing various courses of crops employed in Scotland, but all of them very deficient in grass intervening between the cultivated crops, observes: "We shall now proceed to consider the rotation of six crops, which is deservedly a favourite system in Scotland, in a light soil; first potatoes or turnips; second, barley; third, grass; fourth, oats; fifth, beans; sixth, wheat." Here

* If what has been said of the lenient properties of the carrot, be correct, it may be less exhausting than wheat.

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it may be proper to remark, that the grounds in Scotland, are commonly ploughed three or four times for turnips, as many for barley, two or three times for oats, and twice for peas or beans. Thus it would appear, that in light as well as in heavy soils, much useless and very injurious labour is employed in that country.

This gentleman says, in the strong lands in the Carse of Gowrie, and other fertile districts in Scotland, the following rotation with some variations, is considered preferable to every other: first fallow; second, wheat; third, beans; fourth, barley; fifth, grass; sixth, oats.

Now it is evident, that notwithstanding Sir John very justly considers the Norfolk system exhausting, and injurious to the landlord, and of consequence, eventually the same to the tenant, the most approved courses of crops in Scotland, as described by him, are still much more exhausting and injurious to all the parties concerned.

In the first of those rounds, there are five cultivated crops, and but one of grass; one of those five crops, however, is turnips or potatoes, to be fed away to cattle, &c. This seems to make it less exhausting than the other course, in which only one crop, to wit, grass, is grown to be applied to the same purpose. The bean straw, highly esteemed in Scotland, is in both cases, employed as dry fodder for cattle, &c.

As the farmers in that country have generally adopted the excellent practice of soiling their working cattle and horses, more dung is accumulated than where pasturing is generally practised; this with a very general use of lime, which excites a hasty and unnatural fermentation and decomposition of the animal and vegetable matters found in the soil, may, under such severe systems of cropping, keep up the fertility of the grounds. But it is evident, that without very unusual exertions, or the aid of extraneous enriching manures, little or no progressive improvement can be made. Indeed it would appear, that the soil is far more likely to become worse than better, by the system of management generally employed in Scotland.

It seems that beans are employed on light, as well as on clay lands, in both the favourite rounds adopted in Scotland. How much better then would be, first, beans drilled on a grass lay well manured; second, barley; third, clover; fourth, wheat; fifth, speargrass; sixth, ditto. By this arrangement, half the farm would be annually in grass; large stocks of cattle, &c. might be kept at the least possible expense; the land would soon be so enriched; that notwithstanding there would be less ground annually ploughed, the products of the cultivated crops would be much more considerable than under the present system of management. As a soil may be made too rich for growing small grain, it is by no means improbable that after the grounds have been sufficiently enriched, the last crop of speargrasses might be safely omitted, and the fallow crop commenced on a speargrass lay, which had been only one year mowed or pastured. This arrangement would change the round to

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three cultivated crops, and two of grass in five years. It is presumed that this might be done without diminishing the live stock, as it is believed that two acres of grass grounds highly enriched, will yield quite as much, or perhaps more grass than three which had been made only moderately fertile. It matters not, however, what the cultivated crops are, or what the course of crops may be, provided a proper change in vegetation be attended to, and grass crops enough intervene between the cultivated crops, to enable him to make and keep the soil sufficiently rich to grow the crops that best suit his purpose. Care, however, should be taken to avoid growing exhausting plants, when others that are less so may be made to answer quite as well, and no question but it may often happen that they will be found more lucrative.

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CHAPTER XLIX.

Observations on the different classes of farmers in limited circumstances: also on the injurious error of occupying more land than can be cultivated properly, by the capital employed. Remarks on the ruinous practices too generally pursued by tenants in this country: also on the measures to be taken to prevent these evils. Two distinct systems of mangement, recommended to be practised by the circumscribed cultivator. The extensive usefulness of the grasses when employed by the circumscribed farmer for manure, explained. Also, how they should be applied and managed by him. How the soil is ameliorated by a turnip crop. On growing potatoes on grass lays without dung.

It has been before observed, that the farmer, whether he be rich or poor, may grow any cultivated crops that best suit his purpose, provided he occupies no more land than is consistent with the means employed to cultivate it, and a sufficiency of grass crops intervene.

There are several different grades of farmers, who do not employ a sufficiency of capital to cultivate their grounds very advantageously: First, those who are really wealthy, but as this wealth consists principally in lands, their monied capital is too circumscribed to cultivate them to advantage. Many of these gentlemen may be well aware of this; but the trouble and perplexity arising from the too generally destructive practices of tenants in this country, may induce them to keep the whole in their own hands. Secondly, those who add farm to farm in place of cultivating the grounds they already possess, properly. Thirdly, those who build extensive barns and dwelling-houses, before they have provided a sufficient stock of cattle, &c. to farm properly. Fourthly, those who prefer hoarding up the money saved by rigid economy, or putting it out on interest, to employing it on their farms. It is certain that more money cannot add to the happiness of the last mentioned cultivators, as they already possess much more than is properly applied by them. The community, however, is interested in the better cultivation of the soil occupied by them.

The fifth and most extensive class of circumscribed farmers are those who are actually poor. It is to this class of cultivators that I shall principally apply my subject, as in doing this the others will be equally well informed of the best means of ordering their limited establishments. as they would be, if what is advanced were immediately addressed to them. There can be no essential difference in the practice of those *who cannot* and those *who do not* furnish sufficient capital to cultivate the soil in the most advantageous way; unless it be that, arising from the great disproportion of funds employed, where such a multitude of cultivators are concerned. This, however, introduces no serious difficulty, if the general principles

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by which the circumscribed farmer should govern his practice be kept in view; and he carefully employ his agricultural funds to the best advantage in the manner or way which these principles require.

We too generally see that farmers who are scarcely able to cultivate twenty acres of ground as it ought to be done, are seldom content with one hundred; although they might thrive on the former, and but too generally continue poor on the latter. This fatal error has induced many of them to make extensive clearings. As this has been done, and the country as well as themselves is highly interested in their welfare, and the improvement of the soil occupied by them, they should be made acquainted with that mode of management and cultivation, best calculated to promote valuable crops, and improve the fertility of the soil.

The owners of land in England act wisely. They will not rent to those who have not a sufficiency of capital to do justice to the soil. This is too seldom considered in America, and the soil is ruined of course. Hence it is, that the prejudiced or superficial observer, asserts that the soil and climate in this country are incapable of producing such luxuriant crops as are grown in England, than which nothing can be more erroneous; yet we see that as soon as a cultivator from that country arrives, he is persuaded by our own countrymen, and also by too many books written here, that he must not sow or plant as much seed as he sowed or planted in England, Ireland, or even on the poor heaths of the Highlands of Scotland.

So completely is this error established, that I never knew but one cultivator from either of those three countries, who had observation and resolution sufficient to act contrary to this very absurd but at the same time fatal delusion.

But to return. It would be far better to keep up the fences, and leave the grounds to nature, than to place them in the hands of men whose system of farming insures destruction. Nature in this highly favoured country speedily covers even thin soils with white clover, and better grounds are as quickly covered with superior grasses. The decay of these will gradually enrich the land. If cattle be admitted, and not suffered to carry off in the evening the greater part of what they have gathered in through the day, the grounds will be sooner enriched: provided a good covering of the grasses be always preserved.*

* By passing through the body of animals, the food eaten by them is highly incorporated with animal matter. These are very far richer, and afford much more food for plants than vegetable substances; especially if the animal who makes the manure is fat or in good condition. The urine made by the cattle is also very enriching. The vegetation eaten and elaborated by them while green, returns much more to the land, than can do the grasses when suffered to rot on the soil. As in first drying, and after this decaying, very much of the nutriment contained in them is exhaled and washed away by heavy rains. No question but there is a loss in dung, &c. dropped by the cattle while pasturing; but this is far less than happens in the too usual mode of management, when pasturing is properly ordered, as will be more fully explained presently.

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Some gentlemen in their mistaken zeal to etablish the invaluable practice of soiling, wish us to believe that the manure promiscuously dropped by cattle when the grasses are pastured does but little good, the reverse of this, however, is true.

To prove their erroneous theory, they have cited commons that had remained open a great length of time, and still continued as poor as they were, so far back at least, as the memory of man could trace their comparative situation.

These writers, however, should have recollected that the commons were always overstocked; so much so, that the little grass produced by them was constantly cut off as close by the ground as it was possible for hungry horses, cattle, sheep, &c. to bite; that the greater part of the little which these animals gathered through the day, was carried off by them in the evening; that the dung left by them on the grounds, lay exposed, without the least shelter from the tops of the grasses, to the injurious effects of the sun and air; that much of the juices from it, which would sink into an open free soil, well covered by the tops of the grasses, was washed away by the rains, &c. in consequence of the ground being greatly consolidated by the feet of the multitude of animals, who were continually roving over them in search of a better bite.

Time will clothe thin soils with a scanty covering of grass, even when exposed to almost every disadvantage: still the tops of the plants being (in the case now under consideration,) eaten off close to the ground, so soon as it is possible for hungry animals to crop them, they become too debilitated to act in energetic consort with their roots: thus the latter become equally as debilitated as the former; consequently the vegetation within the soil can be no better than that above it.

The grounds therefore, in despite of every effort made by nature, are compelled, by the mismanagement of man, to continue poor. However, as he does not see the causes which produce this effect, he plunges still deeper into error by drawing false conclusions from what has happened. He might, however, have observed, that only one year's pasturing in this way, of the richest meadow, will debilitate the roots as well as the tops of the plants so much, as greatly to curtail the product of the ensuing year.

Yet we see too many farmers suffer their live stock to eat of the grasses on their meadow grounds, as close as it can well be done, until vegetation is locked up by frost. Some are not content even with this ruinous practice: they turn in their cattle, horses and sheep again in the spring to graze, for some considerable time before the fields are shut up to grow grasses for hay.

When a good covering of the tops of the grasses is continually preserved, the health and vigour of the roots are maintained; they spread deep and wide through the soil. This covering greatly shields the dung and urine, made by the cattle, from the injurious influence of the sun and air; it also opens and expands the soil, so that more of the juices sink into it when washing rains occur: es-

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pecially as the progress of the water is considerably retarded by the opposition it meets from the covering of grass. The grosser particles of the dung naturally adhere to this mass of vegetation; it also affords ample food and shelter for animalcula, and the animal matter introduced by them is considerable.

If the dung dropped by the cattle, be broken into pieces, and spread over the soil, the latter must be much more benefited in proportion to the quantity of manure, than by top dressing in the usual way: provided a suitable allowance be made for the loss in that part of the manure, which may happen to be dropped by the cattle, where it can be of but little and sometimes of no benefit to the grounds.

The cause of this is evident, one half the nutritive properties of the dung commonly used for top dressing, is lost by fermentation and decomposition before it is applied.

Notwithstanding, however, it is very erroneous to assert that the manure dropped by cattle in pasture does little or no good, it is evident that the dung which may be saved from the same number of cattle, when soiled, very far exceeds, in usefulness, that which may be obtained by pasturing; so much so, that the comparative value of the latter is trivial indeed, if the former be properly applied and managed; still, the manure returned to the soil by pasturing is highly important to the cultivator, when that practice is properly managed: as the grounds will not only furnish a regular supply of the grasses for his cattle, without any addition to the manure dropped by them, but will also be gradually enriched by this practice.

But notwithstanding these invaluable purposes may be obtained from pasture grounds, and that too with the least possible labour; yet where population and capital will admit soiling to be joined with a regular and judicious convertible husbandry, this practice should be adopted; as it will not only introduce more and far better grasses, but it also improves the soil as much, or perhaps more, in ten or twelve years, than can be done in half a century by the former practice, and at the same time it greatly increases the product of cultivated crops.

But to return to the renters of land. It is certain that if the plough and axe be not limited, the soil will be much sooner ruined, and the timber destroyed, even in the back-woods, than the owners of land in this country appear to conceive. If they were sensible of the impending evil, we might naturally suppose, measures would be taken to prevent the injury. Proper leases, with strict regard to their fulfilment, would generally effect this invaluable end. The inconsiderate farmers who till their own grounds would be stimulated to a better practice, by observing that their neighbours, whose leases compelled them to farm properly, were doing much better than themselves, who had no rent to pay.

The amount of the moderate rent, which is generally exacted in this country, may be readily sunk by the mismanagement of those

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who till their own grounds. Although rents are low, it would be much better to reduce them considerably on improving leases. This would, in a few years, entirely change the face of the soil, which is at present too generally haggard and impoverished, by incessant ploughing and cropping, with scarcely any attention to grass or manure. The advantage gained by the improvement of the grounds would greatly exceed, not only the abatement in the rent, but also the whole amount of it.

The farmer whose capital is too limited to keep a stock of cattle, proportionate to his soil, will find incalculable advantage in a superabundance of the grasses. In fact, they are the only means which he can employ to enable him to farm profitably, or that can prevent the ultimate ruin of his soil. Unless he live in the vicinity of a market for his produce, from whence he may in return bring back enriching manure.

Grass seeds come high if they be annually bought: still a small sum will enable him to purchase a sufficiency of those best suited to his purpose; from which he may grow his own seed. A little practice will teach him how to sow it in the chaff, which will greatly abridge his labour.

When grasses abound they will so far exceed the necessary quantity for his limited stock of cattle, that his soil will be constantly well clothed with this invaluable vegetation. The continual decay of it will enrich his grounds, besides supplying a full grown crop of grass to be ploughed under the soil as manure for every fallow crop grown by him.

The increased product obtained by this simple and rational practice will greatly overpay the trivial cost of the grass seed, also of the gypsum which may be found necessary to excite luxuriant crops of red clover on his thinner soils.

No system of management which promises lasting success and improvement can be cheaper than this, or be effected with near so little labour. In fact it is exactly calculated to promote the ease and tranquillity of an indigent cultivator, and finally to enrich him. By this simple and cheap means he may gradually and regularly increase his live stock with scarcely any perceptible expense, until the number of them becomes equal to the extent of soil cultivated by him.

The usual mode of random cultivation and improvement is not, however, calculated to effect this invaluable end. To do this with certainty, and without perplexity and confusion, two regular, but very different systems of management, should be pursued by the circumscribed farmer. First, his farm yard manure should be liberally spread for fallow crops, so far as it will extend. This portion of his soil ought to be regularly cultivated in the same way as wealthy farmers should cultivate their grounds. As live stock and manure increase, additions ought to be made to this portion of his management until the whole of his farm be reduced to one perfect system of economy. This mode of management will not only pre-

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vent perplexity, but also excite his emulation to excel even his more wealthy neighbours in this portion of his grounds. It will also clearly convince him of the value of good husbandry. This will naturally cause him to hasten the improvement of the whole of his farm by every rational means within the compass of his ability. The very luxuriant and profitable crops obtained by this way will excite his neighbours to follow his laudable example. The remainder, and by far the great part, of his grounds should be subjected to a regular and very lenient course of cropping. Every fallow crop ought to be manured by turning under as full grown a crop of the grasses as the soil is capable of producing.

His fallow crops grown without dung on the best of his grounds may be potatoes, maize, &c. On his grounds of more inferior quality his fallow crops should be peas, beans, &c. One crop of small grain may, unless the grounds be too poor,* succeed each fallow crop, with grass seed sown on it. The grounds must be continued three years in grass before they are again turned up for another round of crops.

The stubble crop of grasses should be suffered to grow and rot on the soil. A good covering of all the grasses ought to be continually preserved, and great care taken to increase the size of this covering to the greatest possible extent before severe frost sets in.

Such grounds as are too poor to produce two crops previously to their being laid down in grass, should be prepared and sown in small grain, in the way that has been recommended in my book on Cultivation, and grass seed sown on the grain. They should not be mowed, but may be pastured, if a good covering of the grasses be always preserved. They ought to lie three years in grass before they are again cropped.†

If from too frequent use of gypsum without enriching manure, or any other cause, it is found that part of the farmer's poor grounds cannot be excited by that substance so as to produce valuable crops of red clover, they ought to be sown on one ploughing, with such seeds as are best calculated to produce a good green crop on them. This should be turned under the soil; and, after the grounds have been prepared in the way before recommended, small grain sown for a crop, to be gathered, and red clover sown on it. The clover ought not to be mowed, but it may be pastured and managed as above directed, for three years; after which the sod

* In this case no fallow crop should be taken. One crop of small grain will be found fully as much as such grounds ought to grow before they are returned to, or sown in grass.

† Here I beg leave to observe, there are some grounds that seem to be very poor which, when manured by gypsum, will grow good crops of red clover. On such grounds, by the proper use of the clover turned under for manure, the farmer may grow a lenient fallow crop, to be followed by small grain; this, however, should be sown in the spring, as winter grain is much more liable to be chilled by the severities of the winter in poor than in richer grounds.

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may be again turned up for a crop of small grain, to be followed by clover. The soil should be subjected to this lenient course of cropping until it becomes sufficiently rich to bear two crops before it is restored to grass.

When the soil is capable of producing grass, no other green crop should be ploughed under for manure. The grasses cost nothing but their seed and the little labour of sowing them, unless the soil be too thin to produce clover without the use of gypsum. In that case, however, the cost of the gypsum will not be any thing like equal to the necessary cultivation, and seed for a green crop, obtained by sowing even buckwheat.

If we may determine the comparative value of this plant and clover, when turned under green for manure, by the apparent nutriment contained in each of them, we have every reason to believe, that a green crop of clover will introduce much more than double the quantity of nutritious matter for plants, than a crop of buckwheat. It would, also, seem that when the ground is good enough to grow the speargrasses, the advantages obtained for ploughing them with their roots under the soil, will be at least equally great, if not greater, than is derived from clover used in the same way. The celebrated Arthur Young has informed the farmers in England, that tares, sown in September on one ploughing, are cut off in time to sow buckwheat on one ploughing, and that if the latter be turned under for wheat, "It is not in the power of *science*, of *theory*, or *practice* to introduce a system more round and complete."* As we cannot determine what may or may not be "in the power of *science*, of *theory*, or *practice*," this assertion is as unguarded as it is contrary to a judicious system of agriculture. The practice, however, may be partially useful in England, where gypsum does not generally act powerfully, and the prevailing attachment to old grass grounds, has induced the farmers there, to grow by far too many cultivated crops, on their fields subjected to the plough, before the grasses intervene.

Grounds managed in this way seem to require, in addition to the manure furnished by the live stock, more assistance than is generally obtained there, by turning under a clover lay, too commonly after the plants have been greatly run out, and the tops have been either mowed or closely pastured

Notwithstanding their old grass grounds, and an extensive cultivation of turnips, enable them to gather and apply much manure, the number of cultivated crops grown on that part of their grounds subjected to the plough, together with the manure applied in top dressing the grass grounds which are mowed, render that article, great as the quantity at first sight may appear, scanty, when applied to all the necessary purposes which their mistaken idea of agriculture requires.

Yet the writers on husbandry, in this country, too generally urge

* See Mr. Bordley's book on Husbandry.

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us to adopt the errors of England: particularly the supposed ameliorating practice of growing turnips. They should, however, have considered, before they became so zealous, in what they, no doubt, believed a good cause, how the soil is ameliorated in England by a turnip crop. If this had been done, they would have discovered, that any plant cultivated by us which produces food either for man or domesticated animals, would be at least equally ameliorating as the turnip, if cultivated and used in the same way.

The British agriculturist who does not exhaust his soil applies dung for the turnip crop, and very many of the cultivators in that country feed them off on the ground where they grew. This returns to the soil all the nutriment afforded by the turnip. Now after all this has been done, we do not hear that the cultivator complains that the small grain, grown after this very expensive system of manuring, is injured by being too luxuriant.

Here it may be proper to remark, that it is far from my intention to depreciate this valuable plant; or to intimate that it is not useful in Great Britain, where it is generally believed maize cannot be grown: especially as a mistaken system of management requires more manure than can be obtained from their old grass grounds, aided by a clover lay, as often as this grass intervenes in the general system of cultivation pursued in that country.

The two distinct systems of management, recommended to be pursued by the circumscribed cultivator on the same farm, will not only be very profitable to him, but also highly interesting to agriculture. They will clearly determine the comparative value of the dung and the grasses, when each of them is separately, and systematically employed as manure for the soil: also how far we may solely depend on the grasses for promoting good crops, and at the same time improving the soil. Of this we know, at present, but little, as the application of them has hitherto been mixed with the intervening use of other enriching manure; or else the grounds have been too severely cropped, before the application of the grasses for manure had been repeated.

The mode of management recommended to the circumscribed farmer, was not adopted by me until my removal to the back-woods. My stock of cattle has since then been very deficient, when compared with the extent of cleared grounds which has happened to fall into my hands, very much exhausted by perpetual ploughing and cropping.

I have, however, been sufficiently informed of the value of the tops and roots of grasses, when applied for manure, to be fully convinced that if a proper system of management be pursued, they may be rendered invaluable to the farmer, whose limited capital will not admit him to keep a sufficient stock of cattle. By the proper use of them, he may, no question, annually increase the product and fertility of his soil: also, gradually increase the number and value of his live stock, with far less labour than is employed in the present mode of management pursued by circumscribed farmers.

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That part of his management which has the advantage of farm yard manure, will be very inconsiderable in the beginning. It will, however, be much more productive than that which depends on the tops and roots of the grasses alone. The only difference in the labour, will be hauling and spreading the manure, together with the destruction of more weeds, introduced and excited by the dung, and gathering more productive crops.

No question, however, but the product of the crops from the grounds manured with the tops and roots of the grasses alone, will very greatly exceed that which could be obtained from the same land by the too general random practice of circumscribed farmers: even admitting that the whole of the dung made by their scanty live stock, be applied in their irregular and exhausting system of management. It is also evident, that the labour generally employed by them, greatly exceeds that which will be found necessary to execute the system proposed.

Red clover will certainly far better suit the circumscribed farmer, than the speargrasses, except on that portion of his soil where farm yard manure has been spread, or where the grounds are naturally rich, and have not been exhausted.

Luxuriant crops of this grass may be readily excited by gypsum; and while the soil is kept well stored with vegetation, a free use of that substance cannot be injurious. It may now be obtained in any part of Pennsylvania, where the roads are only tolerable, so as to cost less than any other manure that is equally valuable. Notwithstanding that frequent mowing through the season, or close pasturing, weakens the lateral roots of red clover, and the taproots are thrown out by frost, it would seem if the stubble crop be suffered to grow and rot on the soil, and no more than the first crop be annually mowed, and after this a good covering of grass be preserved, that the lateral roots will continue much more vigorous than when this plant is managed in the usual way: of consequence, it is far less subject to be destroyed by frost or the scorching rays of the sun.

It appears from the long and vigorous continuation of many of the plants that survive, age cannot be justly considered the cause of the early death of the greater number of them. This seems to proceed from their being exposed by frequent mowing and close pasturing, to the injurious effects of frost, and the scorching rays of the sun. Nature has not formed the plant to withstand frequent mutilation, any thing like so well as the speargrasses. We also see that even brambles, hardy weeds and sprouts, from the roots of trees, are often destroyed by being frequently cut off near to the ground by the scythe. We may also observe that while the lateral roots of red clover continue healthy, that they hold the taproots so firmly in the ground, that the plant maintains its natural position, even when the soil around it is heaved up so high by frost, that the crown of the plant stands in a hollow formed by the expansion of the ground: likewise, that when a general thaw takes place, and the

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soil sinks, the taproot maintains its natural position in the ground, and the plant remains unhurt.

This is best seen when the plants are young in the stubble crop, the first winter and spring after the seed was sown. It should, however, be observed, that it sometimes happens that when red clover has been sown on buckwheat, that many of the plants are heaved out by the frost of the ensuing winter and spring. In this case, it appears that the roots of the plant do not become sufficiently large and strong before frost puts a stop to their growth.

When potatoes are grown by the circumscribed farmer, on his best grounds, with the grasses turned under for manure, and the grass crop be a good one, it will be best to plant the sets by trench ploughing, as directed in my book on Cultivation. This will save a considerable part of the manure arising from the tops and roots of the grasses from waste, when the crop is gathered. It will remain safe at the bottom for the growth of small grain, and grasses following the potatoes.

The plants may be arranged agreeably to Mr. Watson's practice, described in my book on Cultivation. So soon as the size of them will admit, they should be thinned, leaving but one of the most thrifty growing from each set. In pulling up the supernumerary plants, great care should be taken to remove the roots, otherwise they will grow from the stubs left behind, and being mutilated, injure the crop more than if no attempt had been made to remove them. If Mr. Watson's plan be adopted, the number of the plants remaining after the crop has been thinned, will be more than some farmers consider sufficient, when farm yard manure has been applied for that crop. As this gentleman planted on thin pasture grounds fed bare, and some of his potatoes grown in that way, weighed one pound, wheat or barley may safely follow this crop, when it is grown on a good soil well manured by the tops and roots of grasses. Grass seeds should be sown on the small grain, and the grounds remain three years in grass before they are again turned up for a fallow crop.

The early and vigorous growth of the plants, as well as the product of the crop, will be greatly promoted by rolling the sets in gypsum, while the moisture arising from cutting them is fresh on the set. They should be spread out to dry, and great care taken not to handle them till planted, so that the gypsum be not rubbed off.

If lime can be readily procured, and the cultivator's capital will admit the use of it, the product of the potato, and also the grasses following it, together with the improvement of the soil, will be greatly promoted by spreading thirty bushels of it to the acre, and incorporating it with the surface of the soil, in the way recommended in my book on Cultivation. If this be done, it is considered best not to thin the potato plants, except where more than two may happen to grow from each set; provided the soil be a good one, and a luxuriant crop of grass has been ploughed under for manure.

If stones, stumps, deficiency of proper instruments, or any other cause, prevent trench ploughing, the potato sets may be planted in

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the usual way, by turning the sod with a good crop of grass over them. In this case the furrow slices should be leveled with the roller, and well pulverised with the hoe harrow or skim, with the tined harrow following lengthwise of the furrows, as deep as it can be readily done, without disturbing the sets, or turning up the sod. If this be not done, and the ground is close bound by the roots of the grasses, many of the plants will spend much of their time and strength in growing under the sod before they can either penetrate it, or find their way out through the seams formed by the furrow slices, and the crop will be greatly curtailed.

As the potato sets cannot be covered by the plough in spots which obstacles render inaccessible to it, and the extent of those spots will not be determined, until after the rest of the field be planted, the pulverising of the soil, should be deferred until the vacancies be planted by covering the sets with the sod turned over them with the hand hoe. Care should be taken to turn the sod well over them and around the obstacles, and at a proper depth. As this cannot be done without cutting the sod into small pieces, the implements by which the soil is pulverised, should be lifted over those spots in passing through the field, otherwise the short pieces of sod will be turned up. By the time the crop requires cultivation, the sod will be considerably consolidated by rain, and the roots of the plants; consequently if care be taken in passing through those places, many of them will not be turned up by the skim, if that instrument be sharp.

When the covering and roots of the grasses are insufficient to produce valuable crops of potatoes, with a crop of small grain and grasses after it, the circumscribed farmer may bring his cornstalks, straw, leaves and offal vegetable matter, into valuable use. As, however, the fermentation and decomposition of these dried substances progress slowly when they are not saturated with the juices of the cattle yard, they, together with the scanty growth of the grasses, may not be sufficient to expand and divide the covering among the sets, as it ought to be done for an advantageous growth of this root, if the crop be planted by trench ploughing. In that case, the cornstalks, &c. should be spread over the lay, and the sets covered in the usual way, by turning the sod with these substances and the tops of grass, over them. The farmer, however, should be careful to have them so far decomposed, before they are applied for the crop, as will render them as useful to the grain and grasses following, as can be expected after the loss sustained by ploughing them up, when the potatoes are gathered. If this be not done, the more solid remains of these dried substances will be dragged up in heaps, or spread over the surface by the harrow, when the small grain is sown. In this state they will perish and afford but little nutriment for plants.

But when these substances are applied for such fallow crops as may be gathered, without turning up the soil, they may be ploughed under without any further decomposition, than will render them

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sufficiently flexible to admit the application of enough of them. Some of these substances will be sufficiently flexible to be turned under when soaking wet; still a much greater quantity, even of these, can be applied after fermentation has introduced a great heat, as this causes them to become much more compact. A shaded situation, where rain has access, is most favourable to a general and rapid fermentation of them. The heaps ought to be formed so as to admit sufficient moisture and air to pass generally through them. To effect this, they should not be heaped up high, nor placed in hollows where the water will lodge in sufficient quantity to retard or prevent fermentation.

Dried or green weeds which have perfected their seed, are very improper manure for a potato crop. Ploughing up, or otherwise gathering the product, spreads the seeds of the weeds through the soil as if sown for a crop. This will greatly injure the small grain and grasses following.

They may, however, be very safely and profitably applied for such fallow crops as can be gathered without turning up the manure.

As the unavoidable evils introduced by ploughing out a potato crop, especially where many seeds of weeds are incorporated with the manure, form a very striking constrast between the usual cultivation, and that recommended by me, I wish the reader here again deliberately to consider, that not only the potato crop, but also every fallow crop cultivated in the usual way, subjects the farmer to great loss in manure by turning it up during the cultivation of the plants. The same also happens when the soil is prepared for the small grain following that crop. The seeds of the weeds are likewise turned up and spread abroad to poison the small grain, and grasses following it. But this is not all; after expending much useless labour to effect this very injurious purpose, and also to mangle the fallow plants, the soil is not kept any thing like so open and mellow, for the ready admission of the roots of the plants, as when this purpose is effected by fermentation alone. A well directed fermentation is also the most powerful and least expensive agent, that can be employed in the destruction of weeds.

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CHAPTER L.

Instructions for growing turnips and maize on grass grounds, without the use of dung Also, for cultivating fallow crops, sown broad cast, to be followed by small grain. The economy of buckwheat considered, and whether it would not be better to sow it early in the spring, than at the usual time It is shown that too free a use of the plough, and but little attention to grass and rearing live stock, are the principal causes of the poverty, which, too generally, prevails among circumscribed farmers. Also, that building costly dwelling-houses, barns, &c. before a sufficiency of live stock has been introduced to farm to the best advantage, is, saying the least that can be said of it, a very injurious practice.

TURNIPS require a richer soil than either potatoes or maize; therefore, this plant should not be cultivated by the circumscribed farmer, but on that portion of his grounds where farm yard manure is liberally spread, except the soil be recently cleared from its wood, or is deep and rich, and also covered by a luxuriant crop of grass.

This should be turned under by trench ploughing, but not more than eight inches deep, lest the enriching matters may not be sufficient to excite a proper fermentation for the growth of this plant. The ground should be ploughed in time to admit sufficient fermentation of the vegetable substances to promote a rapid growth of the plants. If this be not done, they will be in imminent danger of being cut off by the fly before their rough leaves are formed. The proper management of this crop has been described in my book on Cultivation.

The circumscribed cultivator may obtain good crops of maize from that portion of his grounds which cannot be dunged by him, unless they have been too much exhausted, and, at the same time, gradually enrich the land. In this case a good crop of grass should be turned under in the fall. This will secure the rich juices contained in the grasses: if ploughing be deferred until spring, a great part of these juices will be scattered in the air, or exhaled by the sun, &c. As the weather may favour the growth of the grass, especially of the hardy kinds, the furrow slices should be leveled by the roller, and the seams between them well closed with the tined harrow. If it be found that the grasses have grown so much as to promise injury to the crop, before the plants have grown large enough to be cultivated, they should be eradicated by the hoe harrow, with the tined harrow following it previously to planting.

If the soil be a good one, it ought to be trench ploughed. It should, however, be recollected, that notwithstanding the soil is good, turning it up eight inches deep, places that portion of it which is least favourable to vegetation uppermost: consequently the fur-

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rows for planting had better exceed, than fall short of being three inches deep.

The early growth, ripening, and product of the crop will be greatly promoted by coating the seed well with gypsum. If that substance cannot be had, a small handful of ashes spread over the seed in each cluster before it is covered, will produce nearly the same effect. If the ashes have been leached, the quantity should be increased.

Practice seems to have determined that, when maize is planted in rows, five feet and a half is a good width for the intervals. Observation also appears to favour this width, as on an average a full sized plant measures, as the leaves naturally hang, about four feet and a half across the widest part of it. The leaves, except those which may happen to get entangled, naturally incline toward the intervals, in search of light, air and the nutriment gathered from the atmosphere.

Not more than one plant should be left standing at the distance of eighteen inches apart in the rows, even when the soil is good, and prepared as above directed. This will introduce 5,280 plants to the acre, which are sufficient when either gypsum or ashes are applied.

If, however, thirty bushels of lime be spread, and managed as explained in my book on Cultivation, two plants may be left standing at the distance of two feet asunder in rows. This will introduce 7,920 plants to the acre. It should be observed that, where gypsum can be had, it will greatly increase the crops of small grain grown on the grounds that cannot be dunged, if the seed be well coated with this substance previously to its being sown.*

The number of corn plants mentioned above, will be found too many for a soil that is not very good. If it be only middling, and the intervals five feet and a half apart, but one plant should be left standing at the distance of two feet in the rows. This arrangement introduces 3,960 plants per acre, which will be sufficient to grow thirty-five to forty bushels of shelled corn to the acre. In such grounds, six inches will be sufficiently deep for ploughing, where the tops and roots of the grasses alone are used for manure. If lime be spread and ordered in the manner before directed, two plants may be left standing at the distance of two feet and a half asunder in the rows. This introduces 6,336 plants to the acre, and these are sufficient to grow from sixty to sixty-five bushels of shelled corn per acre.

If the crop of grass, to be turned under for maize, be deficient, this ought to be made up by spreading either straw, leaves, cornstalks, weeds, or other offal vegetation in sufficient quantity, and turning them with the grasses under the soil. The dried vegetable matters will be better prepared to promote the growth of the plants by lying under the sod through the winter. The farmer, however,

* This has since been more fully explained, and the causes that produce this astonishing effect considered.

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should remember, that if they are hard woody substances, such as cornstalks, &c. they cannot be ploughed under in large quantities, unless a sufficient decomposition has been previously effected. In either of the cases mentioned above, the maize should be followed by small grain, and grass seed sown on it. The grounds ought to remain three years in grass, managed as has been pointed out, before they are again turned up for fallow crops.

Here it may be proper to observe, that maize is cultivated with less labour when planted in clusters at right angles, than when it is arranged in rows; therefore, when the plants are not too numerous to be introduced at right angles in the usual manner, it may be best to plant in this way. I have never seen corn ear or fill better than when it was planted at right angles, of from four and a half to five and a half feet asunder, even when four plants were generally left standing in each cluster at the wider distance. We certainly know too little of the proper arrangement of this plant: consequently have much yet to learn. It may, however, be proper to remark, that until mathematical precision governs our practice, at least in our fallow crops, but little of the proper arrangement of this, or any other, plant can be known.

Beans and peas are unquestionably very lenient plants. Either may be cultivated on such soils as are too thin for more exhausting fallow crops, but are, at the same time, good enough to produce a profitable crop of them, and the small grain and grasses which should follow them.

For these fallow crops the circumscribed farmer will also find his dried offal vegetable matters very profitable manure, if the grasses, to be ploughed under for them, in the fall, are not found sufficient to promise profitable crops, and the improvement of the soil.

Here I beg leave to observe that no round of crops can be justly considered profitable, unless the soil be actually ameliorated by the system pursued: more especially where the circumscribed farmer is concerned; for he can have no rational prospect of suddenly recruiting the grounds, which his folly or avarice has exhausted.

Cultivated fallow crops properly ordered are, without question, the best, and most profitable preparation of the soil for small grain. It, however, clearly appears, that the labour of planting, horse and hand hoeing, &c. will frequently render it impossible for the circumscribed farmer to pursue this invaluable practice, in that part of his grounds on which he may safely and profitably grow fallow crops without dung, to be followed by small grain, and the grasses after it. It therefore becomes necessary to point out how he may deviate from this better practice, without preventing the improvement of his grounds.

The Albany and lady pea are lenient plants. Notwithstanding many assert that neither of them is profitable, I believe this opinion does not originate in any real deficiency in the plants themselves, or in the climate. It seems to arise, too generally, either from an improper, or ineffectual cultivation, or an impoverished

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soil. It is, however, evident that the most prolific plants cultivated by us, are, in general, still more uncertain and unproductive, when they are no better treated. The cause of this is evident, for but few, if any, of these plants are capable of living on so little nutriment.

Buckwheat is considered by too many an exhausting plant, although it will live and produce crops on much less nutriment than most other plants. This superior property seems to have induced many farmers to continue the growth of it, on such soils as would not grow plants which require more food, until they have become so much exhausted, that even crops of buckwheat worth cultivating, could not be obtained from them: as this was the last plant in general use which *did*, or *could* find a scanty support in the soil, which folly or avarice had exhausted, the cultivator transfers the blame, originating in his own wretched mismanagement, to it.

These facts seem to prove that buckwheat may be justly ranked among the most lenient plants commonly cultivated by us. No question but peas and beans, or any other lenient plant, would be thought equally exhausting by these cultivators, if they had happened to be as generally cultivated by them

There is no plant that will not eventually exhaust the soil, when a system of management calculated to effect the evil is continually pursued. It is, however, equally evident, that there is none, tobacco not excepted, that may not be grown without producing this injurious effect, provided proper management be pursued. My countrymen on the eastern shore of Maryland too generally blame tobacco and maize for impoverishing their soil. They might, however, have readily obtained much greater products from both those and every other plant cultivated by them, and at the same time improved, ininstead of impoverishing the soil.

In this I cannot be readily mistaken, as I lived forty-two years among them, and was not an idle spectator of the progress of farming, after I became old enough to observe and reflect.

The foliage of buckwheat seems to be well calculated to gather large supplies from the atmosphere. The body of the plant appears to consist of a much larger proportion of water than plants in general. This not only appears in the texture of it when green, but also in the straw after the crop is gathered. The slovenly practice of threshing out the grain on the soil where it grew, and leaving the straw to rot in heaps where it was threshed ,too commonly occurs; this clearly proves, that after the water contained in it has evaporated, the more solid contents of the straw are trivial indeed, when compared with the bulk which had at first appeared in the heaps. Hence it is, that farmers remark that buckwheat straw makes but little manure. Sheep, however, will eat it, so will horned cattle, especially if it be salted, and they cannot get salt in any other way, therefore it may be profitably used in this way when the farmer's hay happens to fall short; also for litters, as the open texture of it is well calculated to imbibe much of the juices of the cattle yard.

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I have been induced to defend the character and economy of this plant, lest the injurious, and as I believe very erroneous opinion of its exhausting properties, might deter some cultivators from growing it: also, that notwithstanding peas may be more profitable if sold for exportation, but little of them are consumed in our families, and farmers have not been accustomed to feed their live stock with them: whereas buckwheat is extensively and profitably used for both these purposes. The farmer has been accustomed to cultivate it, and the seed is much cheaper, and more readily procured, consequently he will greatly prefer sowing it broad cast, as a preparatory crop for small grain, provided it should be found equal to peas for that purpose.

I believe buckwheat may be more profitably grown if sown early in the spring. This opinion, however, may or may not be correct, as I do not profess to have any considerable practical knowledge of the cultivation of the plant.

I also suppose that if more seeds were sown, the plants would branch less, and the blossom and seed more generally form at or about the same time, and on or nearer to the top of the plant: of consequence much less grain would be shattered before the crop was gathered and threshed out. But in this I may also be mistaken; still I consider it proper to recommend sowing, on a small scale, double the quantity of seed which is commonly sown, and increase or decrease this quantity as observation and experience may direct.

Farmers say when buckwheat is sown early the blossom is killed with the sun. They, however, very frequently complain, and not without cause, that the same happens when it is sown at the usual time. They also tell us that the excess of rain produces the same injurious effect, when the weather has been such, that the deficiency in the crop could not be attributed to the heat of the sun. The fact is, that the properties of this plant have been but little investigated. It is generally sown in this country at random, on grounds not half cultivated, and very frequently too poor to grow any thing but it, or other plants that will live on very little nutriment.

As it is generally believed that buckwheat by its very rapid growth and extensive shade destroys brambles, and other hardy vegetation, better than any other crop that is sown broad cast, it is often sown to effect the double purpose of killing this vegetation, and producing a crop. However, so far as my observation has extended, both purposes have been defeated; neither it, nor any other plant with which I am acquainted, can be advantageously grown on grounds that have not been half cultivated: especially where brambles and other hardy vegetation abound. Much buckwheat is grown in the neighbourhood where I reside, on soils that have been exhausted by perpetual ploughing and cropping. When it is not destroyed by an untimely frost, it and oats seem to be the most certain crops grown here on grounds of this description. The grain, however, when no injury has been done by frost, hangs much

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thicker on the plants some years than others. This seems readily accounted for, without reverting to the injury that may be sometimes done by excess of rain or heat. The blossoms produced by this plant are very numerous: therefore it is to be expected that many of them will be abortive, unless the season happens to be very favourable: especially if the soil, as commonly happens, be thin or poor.

Buckwheat will withstand a considerable degree of frost while it is young, and is not easily destroyed. This is seen when farmers, as many of them term it, subdue the sod by growing it previously to planting maize, for it becomes a very troublesome weed among that crop.

It has very frequently happened that good crops of buckwheat have been obtained by what are called volunteer plants coming up after the grounds where it had been grown the preceding year were ploughed for a spring crop. In consequence of a luxuriant growth of buckwheat before the spring crop was sown, the plants were suffered to remain. This, with various other facts founded on inquiry and observation, have induced me to believe, that it would be better to sow that grain on a grass lay, prepared in the way that has been explained, as soon in the spring as it might be safely done, than to risk, by sowing it at the usual time, the frost which often happens in some climates in August, or even the untimely frosts that frequently occur in every climate in this country in the fall, and which, in every place where I have been, often injures, and sometimes destroys, the product of this plant. By sowing early in the spring, the crop might be removed in time to admit a proper cultivation with the hoe and tined harrow for seeding small grain in the fall.

Maize will withstand more severe frost in the early part of the spring than buckwheat. For, so far as my observation extends, if the latter be stripped of the leaves formed when it penetrates the soil, before it forms branches, and leaves on them, it invariably dies: whereas maize is seldom destroyed by being cut off close to the ground by frost. This being the case, buckwheat cannot be safely sown as early in the spring as corn may be planted. It may, however, be safely sown at or about the usual time of planting maize.

If buckwheat cannot be profitably grown to prepare the soil for winter grain, it will certainly do this for the crops of small grain sown in the spring: provided the lay be prepared for it, and also for the small grain following it, in the way that has been recommended in my book on Cultivation.

Either the Albany or lady pea* sown broad cast will prepare the soil for winter grain, and the grasses following it, if the cultivation before described be pursued. In either case the good crops of the

* So called on the eastern shore of Maryland: but, if my memory be correct, it is known in New Jersey by some other name.

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grasses should be ploughed under for the fallow crop. If the grasses be deficient, this deficiency ought to be fully made up by dried offal vegetable matters, ordered in the way that has been explained.

When it can be done without injuring the soil, the farmer should always take two cultivated crops before the grounds are laid down in grass. The cultivation of the first crop is vastly more expensive than that of the second; especially where obstables obtain: of consequence the principal part of the profit arising from both crops is gathered from the last; particularly when a proper system of management is pursued, as this greatly reduces the expense of putting in the small grain.

The cultivator, however, should never forget, that if the grounds be too poor to grow two crops without being made still poorer, no prospect of present advantage should induce him to grow more than one before they are returned to grass.

The foregoing system of management may be safely and profitably pursued by the circumscribed farmer until his stock of cattle has been sufficiently increased to furnish dung enough to cultivate the whole of his farm in that way, which is much better calculated to increase his annual revenue. Until this can be done, he has no just cause to complain, as no business can be pursued to the utmost advantage without a sufficient capital to carry it on.

In this country land is very cheap: an excellent ready cash market for the produce of the soil generally prevails. This offers every rational encouragement to the poor but industrious farmer, who depends principally on his own labour, and that of his family, for cultivating the soil occupied by him. He is but little affected by the high price of labour, or the idleness and insolence of workmen, which take place in every country where labour is scarce, unless the laws be oppressively severe.

The principal reason why this class of farmers so seldom become wealthy, and but too frequently continue poor, is the desire of immediate returns from cropping, and the mistaken idea that the profits to be derived from rearing live stock, progress too slowly to answer their purposes. This induces them to crop the soil yearly, with but little attention to grass or an increase of cattle, until their grounds become so much exhausted that rest is absolutely necessary to procure crops worth gathering. The soil being greatly impoverished, and the seeds of the grasses destroyed, as far as perpetual ploughing and cropping can effect this ruinous purpose, the grounds rest with no other covering, but that of some scattering and debilitated grass and weeds. This exposes the soil to the very injurious action of the sun, wind, washing rains and melting snows. When such grounds are ploughed for crops, instead of being richly stored with grass roots, and well covered by their tops, scarcely any vegetation is found to replenish them, or to nourish the crops grown on them.

These ruinous practices naturally introduce poverty of soil, and

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its inseparable companion, poverty of purse. This, however, is not all, it entails on posterity the wretchedness introduced by their inconsiderate forefathers, or an Herculean task to counteract the curse of poverty, which their negligence had introduced. Whether Satan is also the instigator of this evil, I do not presume to determine, but certain I am, that it is much greater, (so far as farming be concerned,) than the curse entailed on the soil by the fall of Adam. That seems to consist simply in brambles and thorns, including in these, such other vegetation as would compel man to earn his bread by the sweat of his brow. This curse we may all see is irrevocable, but we may also, at the same time, observe, that if man complies with Heaven's mild decree, and removes those obstacles to the growth of plants, which better suit his purpose, agriculture flourishes, and his rational wants are abundantly supplied.

But when the hand of folly introduces the additional curse of poverty on the soil, this insatiable monster, like Aaron's serpent, swallows all the rest. Even brambles, thorns, &c. (the mild chastisement of Heaven,) cannot prosper where poverty has obtained dominion over the soil, as may be readily seen, for this and every other vegetation grown on such grounds, looks sallow, starved, and debilitated.

That man is inexcusable and ought to be punished for this sin against common sense, himself, his posterity, and the community in which he risides, is evident.

Before this inconsiderate being enters the forest, glade or prairy, nature had been for ages enriching the soil for his use, in the way that has been described. The fertility of it might be preserved and increased, even by the circumscribed farmer, if a system of agriculture calculated to keep the ground fully replenished with decaying animal and vegetable matter was practised, and due attention were paid to the augmentation of live stock, in proportion to an increase of ability, instead of the ruinous practice of perpetual ploughing and cropping.

Reason, alone, demonstrates this interesting fact. It has also been clearly proved by actual practice, in almost every neighbourhood, by the successful enterprise of farmers, who commenced their business on lands bought on credit, and covered with timber, without any buildings on them, and with not more than a pair of working cattle, and cows barely sufficient to supply the family with butter and milk. Nay, more, some who were not half as well stocked as this, have paid for their land, acquired an extensive stock of cattle, and become wealthy, although their mode of management was very inferior to that which has been proposed. They, however, increased their live stock in full proportion to the means furnished by the system of management employed by them.

From first to last, they have been enabled to live better, and vastly more independently than those who relied principally on the plough. The cause of this is evident: milk, butter, cheese, wool, meat, hides and manure, are continually increasing. It is evident

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that but little manure can be obtained in the beginning; however, where that little is spread, the product is greatly increased, as is also the fertility of the soil for a succeeding crop, and the grasses following it. Where a plenty of good grasses and hay prevail, young cattle will grow as much or more in one year, than they do in two when kept on pasture, fed bare during summer, and on straw through the principal part of the winter.

It is considered proper to remark that, although many circumscribed farmers, make considerable progress in increasing their live stock, their laudable enterprise, however, is too often suddenly checked, before they obtain half the number of domesticated animals, necessary to the proper cultivation of their grounds.

This evil originates in the prevailing error, that huge piles of stone and mortar, or boards and scantling, are the best means that can be pursued by the cultivator to improve his farm. Hence it is, that we see almost in every part of Pennsylvania, where it is possible to effect this mistaken improvement, extensive barns and dwelling-houses standing on farms, where we do not observe half the quantity of grass, or number of cattle, necessary for the proper cultivation of the surrounding soil.

If a stranger to the habits of most of these farmers should happen to have business with one of them, he may knock at the front door of the mansion long before he is heard, unless impatience induces him to exceed the bounds of good manners, and he raps loud enough to be heard in the kitchen, where the farmer and his family commonly reside. The building of the huge house and barn had not only prevented the proper increase of his live stock, but also so drained his purse, that proper furniture could not be purchased for the dwelling-house; or he finds, (what he might have known equally as well before he encountered this useless expense,) that the large fire-place in the kitchen, with the mouth of the bake-oven opening into it, renders that room, by far, the most convenient apartment for his family. The same fire that warms them, cooks their provision and prepares economical food for their milch cows, pigs, &c. Every other thing is done there with as little labour and as much economy, as occurred before the castle was built. The labour necesssry to keep the big house and costly furniture, if the latter be also got, in proper order, is also saved, by letting the whole, or at least far the greater part of it, remain unoccupied by them.

Now, although some may say the farmer erred greatly in building a house, which either a deficiency of capital, or the previous habits of himself and family, rendered useless and unfit for them, no man of sense who understands the economy of farming, and is acquainted with the habits of full bred farmers generally, will blame the cultivator for promoting the ease and happiness of himself and family, by living in the kitchen.

The large barn will be found more useful to him than the big house. The advantages arising from it will, however, fall very far short of compensating for spending the money on it, which common sense,

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unbiassed by custom, clearly determines should not have been done, at least until live stock, equal to the demand for manure, had been introduced. The introduction of an expensive establishment by the circumscribed farmer, is certainly as much opposed to reason, as if a merchant, whose capital is too circumscribed to carry on his business as it ought to be done, should expend the profits arising from it, in erecting extensive stores and costly buildings for his family, although he knew full well he could not fill the former, and that the previous habits and economy of himself and family, were opposed to being comfortably fixed in the latter.

In fact, erecting such large expensive buildings is, in common, immediately opposed to the interest and happiness of the full bred farmer, even when his agricultural capital is not injuriously affected by the enterpise. The interest of the money expended on them, together with the necessary repairs of this extensive establishment, will much more than pay for simple cheap conveniences, which will answer all his purposes much better, so far as expensive barns and other costly out buildings be concerned. The large dwelling-house, &c. is exactly calculated to disturb his repose, and perplex *himself* and his family, and subject them to ridicule, unless they lay aside their economical habits, and introduce a proper number of domestics, to render this arrangement comfortable and respectable. This, however, is seldom done, as habit has taught full bred farmers generally, to manage all their concerns with the least possible expense; consequently, living in the mansion-house is, in common, very inconvenient, and the doors of it are kept closed, except on some particular occasion. As the owner does not like to encounter the bustle, expense and loss of time necessary to a sudden emergency, the visiter is generally ushered into the kitchen. Here he dines, sups or breakfasts with the cultivator, his family and workmen.

As man can be happy only in his own way, this mode of management may please the farmer, who neither sees nor feels the impropriety of it. He may, however, discover, when the evil cannot be removed, that after his death, his property will not be *sufficient to* enable him to do equal justice to his children, if the landed estate be kept in the family. If the farm be sold to effect this purpose, it is a hundred to one, whether it will sell for more money than it would have done if the building had been extended no further than simple real convenience required. The judicious purchaser does not expect an income from huge piles of buildings. On the contrary, he knows that the repairs necessary to keep them in proper condition, will be a continued tax on the income obtained from the soil.

This puts me in mind of what I have been informed, happened not long since. A gentleman who traveled pretty often by a very wealthy farmer's house, with whom he was acquainted, had been often pressingly urged by the farmer to call and see him.

As the farmer's dwelling-house, barn and other buildings were not only very extensive, but also made with the best materials that

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part of the country could afford, it was reasonable to suppose that a man of such great wealth, who had encountered the expense of erecting those costly buildings, would also consider it proper to make at least decent preparation, to entertain such gentlemen as he knew lived well at home: more especially those who came in consequence of repeated and pressing invitations.

Accordingly the gentleman called one morning, as he had to pass by the farmer's house, to spend the forenoon and dine with him.

The horn was blown at the usual time. When the workmen had assembled, the gentlemen with them, the farmer and his family were all seated at the same table in the kitchen, and dined together on a dish composed of sour krout and salted pork. This, with a large crock of milk, formed the whole of the dinner, and from the latter each dipped up, with his own spoon, as much as he wished to use.

Several years have elapsed since I was last on the eastern shore of Maryland. I did not, then, observe, that any improvement had been made in the general system of cultivation. There were, however, some cultivators who had improved their mode of management very considerably.

It is now a long time since the cultivation of tobacco was abandoned in the neighbourhood where I was born, except by a few cultivators, on a very contracted scale. Maize, followed by wheat, seem to be the general crops since tobacco was but little grown.

The little dung made by the very scanty stock of cattle, was, while I lived there, commonly spread by the farmer on hill sides, or other poor spots in his extensive fields. Notwithstanding it is obvious that, be this article spread where it may, good certainly follows; still as the quantity was very inconsiderable, and scattered on different spots through large fields, but little perceptible benefit seemed to be derived from it.

Many of the farms in that country are very extensive, and they are in general much larger than in Pennsylvania. After growing one crop of maize and a crop of wheat following it, the considerate farmer commonly lets his soil rest. It was of consequence partially covered by nature, with such debilitated grasses and weeds as she could grow on it. In very many instances, however, a naked fallow, sown in wheat, was added to this system of management. As the grounds, on which this was grown, had been previously resting in grasses and weeds, the wheat crop was commonly better than that grown after the corn.

Mr. Bordley rates fifteen bushels of corn to the acre, when he compares the value of this plant with that of the potato. It, however, happened often while I lived there, that many did not obtain more than ten bushels to the acre, and some not as much. This gentleman in his book on Husbandry says, "A few years since it was generally believed that six bushels of wheat an acre, was a medium produce of a large extent of country, within the peninsula of Chesapeake, but since then, till the Hessian fly took possession of the

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wheat growing there, the wheat culture was improved so as to gain a larger produce in that district." From this gentleman's residence there, and his talents, as well as from the observation made by myself, I am disposed to believe that he has not underrated the average product of that country.

The soil there was originally at least as good as is commonly seen elsewhere. The obstacles to a ready and efficient cultivation are fewer than I have seen in any other place. The bay, rivers and creeks are so situated, that the product of the soil may be sent to market with but trivial expense. The roads are level, easily made, and kept in repair.

In fact, the country is capable of more extensive agricultural improvement than any other known to me. The cultivators of the soil are generally intelligent, and many of them well informed. They know as well as do any other set of men in the world, that the system too generally pursued is a bad one. The curse of poverty, however, was intailed on the soil by their predecessors. They were also early taught to live generously, and perhaps, in many instances, too profusely. This requires funds, therefore no system *can* or *ought* to be adopted by them, which would *either* abridge their crops, or require more money to put *it into* practice, than can be obtained without infringing on that system of hospitality, and social friendly intercourse, which habit has rendered essential to the happiness of themselves and their families.

Now it would seem, that the practice of two distinct systems of management, recommended to the circumscribed farmer, and an increase of live stock in proportion to an increased ability to effect this invaluable purpose, is at least better calculated to promote, and finally establish, a perfect system of husbandry on the eastern shore of Maryland, and perhaps in Virginia also, without abridging any of the cultivator's usual expenditures in his family, than any thing that has yet been proposed.

It is well known, that those who give their grounds rest until nature has covered them with debilitated grass and weeds, obtain more produce, in proportion to the size of their farms, than those who give too little attention to this useful practice: therefore, nearly, if not quite, the same breadth of soil may be cultivated under the system, that has been recommended to be pursued by the circumscribed farmer, as is now done.

It is true that an extensive farm will require much clover seed and gypsum. If the farmer, however, gathers the former from his own fields, and sows it in the chaff, he will not feel the expense; and the facility of water carriage will enable him to purchase gypsum at a very reduced price.

It should also be recollected, that if the management be good, and there be no existing cause which may prevent the action of the gypsum, the grain crops will be considerably increased by the manure, arising from the tops and roots of the grasses.

It is said there are soils and situations in which gypsum will not

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act. It may be so, but it has acted, and that powerfully too, in every soil and situation where I have been; unless the grounds were too wet, or else rich enough to effect sufficient fermentation and decomposition without the aid of this substance. It is also very observable, that we are told of its acting on grounds where it had been formerly applied without effect: also, that it has ceased to act where it was formerly advantageously employed: likewise, that it is a "whimsical" substance. Judge Peters says, "I have ruined a bushel of plaster by a handful of salt."* Also, "plaster on moistened or steeped seed wheat, if it be not steeped in brine, has been useful."† In the Domestic Encyclopædia, volume v. page 384, we are informed that, "one bushel of seed wheat was steeped twelve hours in pickle, and then rolled in plaster and sown through the middle of a field containing eleven or twelve acres: on each side of this, throughout the field, wheat was sown that had been rolled in plaster, but not pickled. The stems of the pickled seed were much superior in luxuriance. After measuring the products of the pickled and unpickled seed, the owner affirmed it as his opinion, that if he had pickled the whole of the seed, his crop would have been increased thereby, not less than seventy or eighty bushels."

Such a multitude of contradictory theories, said to be founded on practice and observation, have appeared respecting the action of gypsum, that nothing certain can be gathered from many of them.

It is, however, well known that where it does act, the beneficial effects produced by it are invaluable. I would, therefore, advise the cultivator to try it on all soils and in all situations, unless the grounds be too wet:‡ especially as I am disposed to believe, notwithstanding all that has been said to the contrary, that this substance, if it be judiciously used, will act, and that powerfully too, in very many situations and soils, and under a variety of circumstances, in which it has been confidently asserted that it will do no good.

It would, however, be only prudent to try it on a small, but at the same time, persevering scale, in cases in which the use of it may have been rendered doubtful, by the discordant and contradictory theories that have appeared.

But to return to the eastern shore farmer. The additional expense to be encountered by him, will be the clover seed, gypsum, and gathering much more extensive crops. The means proposed to cultivate the soil, will make that much less expensive than the present mode of management. Of consequence, the extra produce obtained by a better system of cultivation, will cost the farmer little or nothing. There are few who are acquainted with the value of a grass lay, who will not agree with me, that if the corn crop be grown on a clover sod well stored with the roots of this plant, and a full

* See Mem. Philad. Agr. Soc. vol. i. page 172. † Idem, vol. ii. page 208.

‡ That is too wet to sow wheat sown in the fall after ridging and water furrowing in the way that has been directed, and in that case, the land ought to be drained.

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second crop of the grass is turned under, in the fall, and the maize be followed by wheat, that the product of each crop, saying the least which can be readily said of it, will be double the quantity that is obtained from the injudicious system of management described above.* I have never grown better crops of wheat than those which have followed maize. The practice of sowing wheat while the corn plant is yet standing on the ground, is not a good one. First, the ears and sometimes the plants are broken off. Secondly, it is more laborious, as the seed lying near to the corn plants, cannot be well covered except by the hand hoe or rake. Thirdly, the seed cannot be sown as evenly over the soil. Fourthly, a part of it is arrested by the leaves, and being conducted by them near to, or in contact with the stalk, it lodges there until the fodder is gathered. Fifthly, the grounds cannot be laid so smoothly for mowing the grasses which follow the small grain. Sixthly, The wheat plants are mutilated and trodden into the ground, when the corn and fodder are gathered. These are not, however the evils commonly enumerated by those who reprobate the practice of sowing wheat after maize. They tell us that the growing of the corn plant disqualifies the soil, in a way that they do not seem to understand, for growing the wheat; than which, nothing can be more erroneous, if a sufficiency of nutriment has been provided for both crops. Plants, like animals, cannot prosper unless they have enough to eat. I never grew but one crop of wheat sown while the corn was standing on the ground. The crop of maize was luxuriant: therefore, in removing the grain and fodder, the wheat plants were much mutilated, and trodden into the soil. They looked so debilitated through the latter part of the fall, winter, and early part of the spring, that but little grain was expected. The crop, however, turned out to be far better than was supposed, the quantity was not exactly ascertained, but estimated at about from twenty-eight to thirty bushels to the acre.

* It will be this in the beginning, and increase in due proportion to the increased fertility of the soil.

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CHAPTER LI.

The atmosphere is not, as too many have said, the vast ocean of food for plants. The food to be derived from it, and that from animal and vegetable matters considered. Remarks on the fallacy of the conclusions drawn from the experiment made by the willow; also on the wounded locust. The circulation of the sap considered.

Since writing the foregoing essay on circumscribed farming, I have seen Colonel Taylor's Arator. The practical improvements made by this truly great agriculturist on an extensive and very economical scale, are calculated to astonish the enlightened and reflecting farmer. His system of management seems to be well adapted to the peculiar situation in which Virginia and some other States have been placed by the introduction of a multitude of slaves. By this very impolitic arrangement the labouring class of white and free citizens have been suppressed, discouraged, and nearly rooted out. Hence it is that extensive tracts of land owned by gentlemen are cultivated by their slaves.

As self-preservation is the first law of nature, it would seem that Virginians will not readily admit the doctrine of liberating their slaves until an improved husbandry has made room for, and also effected, a great increase of white inhabitants. If Colonel Taylor's highly improved system of management is, as it certainly ought to be, generally adopted, at least until a better one appears, by the extensive land and slave owners in Virginia, the time will quickly arrive when Virginians (who are certainly as just, humane, and hospitable, as are the citizens of the States where slavery has been abolished) may, with safety to themselves, their families and property, set their negroes free, if this be gradually and judiciously done.* Here I wish, however, to be well understood. The negro, with whose habits, talents and disposition I was intimately acquainted for more than forty years, is as worthy of freedom as any other man. His native talents, notwithstanding they have been oppressed by savage ignorance in his own country, and but too little ameliorated by a state of slavery here, are, if not fully equal to the talents of white men, but little inferior to them. When he is well fed, clothed, and humanely treated, but at the same time well instructed to know that he ought to be obedient to all his

* About forty years ago I liberated all the slaves I had, and have never owned one since. It cannot, therefore, be readily imagined, that I would wish to see slavery existing in any part of my native country, where the rights of man have been so highly and justly appreciated, longer than the oppressed may, with safety to the general community, be suffered to go free.

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master's reasonable commands, and that the relation subsisting between him and his master, requires that prompt and decisive means must be employed to enforce obedience should milder measures fail, he is commonly at least as active, and quite as much attached to his master's interest as white servants in general are; and no man seems to be less offensive, more good humoured, and more cheerful than he is.

Notwithstanding the very superior excellence of Colonel Taylor's practice, it would seem that some parts of it may be improved, and that some of his theories are not in unison with the economy of nature.

In the fore part of his book he says, "If the vast ocean of atmosphere is the treasure of vegetable food, manure is obviously inexhaustible. The experiment of the willow, planted a slip in a box containing two hundred pounds of earth, and at the end of a few years exhibiting a tree of two hundred pounds weight without diminishing the earth in which it grew, demonstrates the power of the vegetable world to select and elaborate the atmospherical manure. This two hundred pounds weight of willow was an amazing donation of manure by the atmosphere to the two hundred pounds weight of earth in which it grew. It was so much atmosphere condensed by the vegetable process into a form capable of being reduced to vegetable food."*

Naturalists formerly believed that the cameleon obtained its food from the atmosphere. It has, however, been discovered that it lives on more nutritious matters than can be found in air alone. The fallacy of the conclusions drawn from the experiment made by the willow is equally obvious. Plants being more tenacious of life than animals, some of them seem to live, at least for a considerable time, on the nutriment derived from the atmosphere alone. This source of nutriment, however, has been clearly proved to be insufficient to support, or perfect, any of the plants commonly employed in agriculture. Still, when the nutriment floating in the atmosphere is used in conjunction with the principal, and more abundant food for plants, it becomes a highly important auxiliary; but could not, as Colonel Taylor seems to imagine, supply all the food necessary to the support and growth of the willow. If his theory be admitted, it follows of course, that plants will grow in a poor, worn out soil, as well as in one well stored with animal and vegetable matters. Experience, however, teaches us that the contrary is true. "The vast ocean of vegetable food" is only to be found in soils rendered rich, either by nature or art, from the application of animal and vegetable substances, which had, while living, stored up in their systems, by the active processes of life, rich decomposable animal and vegetable matters in sufficient quantities to become the support of animal and vegetable life in the succeeding generations of animals and plants.

* See his book, page 51.

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The willow, however, selected either by chance or design, by the experimenter, was well calculated to bewilder and mislead. It is a very thirsty plant. Hence it thrives best on the margin of water courses, or in a soil plentifully stored with moisture. If planted near to a well in which a pump has been placed, and the mouth of the well closed, the roots of this plant will sometimes find their way to the water in the bottom of the well in such great numbers as to fill it up from the top to the bottom.

Such has been the organization of the willow, that by far the greater part of its weight is formed by the water so greedily drunk by it. The wood, therefore, while green, weighs heavy, but after the water has been evaporated, it is very light. Notwithstanding the earths, alkalies, and animal and vegetable matters contained in pure rain, or spring water, are inconsiderable, the two former have been found in those waters after they have been distilled. That water contains animal and vegetable matters even when in its purest state seems to be evident, as it becomes putrid when placed in vessels which cannot communicate putridity to it. Indeed, we may sometimes readily discover by the taste that water has imbibed the properties of these substances by passing through or among them.

The earth in the box must have been watered regularly, during the growth of the willow. Now if the addition of the nutritive, and other matters conveyed into the box, by the water, be considered, and also the nutriment which we may rationally believe, the plant was capable of gathering from the atmosphere, it is by no means wonderful, that the greatly reduced weight of the willow, after the water, which formed by far the greater part of its green weight, had been evaporated from it, was obtained by this inconsiderate experiment.

The experiment on the locust, introduced by Colonel Taylor, to substantiate the same theory, is equally fallacious. He says, "To illustrate the theory that *vegetables extract* their *matter chiefly* from the *atmosphere*, the following fact is circumstantially related. Some years ago, a locust tree at Colonel Larkin Smith's, received injury, which made it necessary to cut away entirely the bark around its body for eight or ten inches, so that its bark above and below, was wholly separated, without a cortical vein between. The wound was entirely covered with a close bandage of some other bark, which lapped beyond the edges of the wounded bark, above and below, and the tree was left to its fate. The plaster of bark never grew to the tree, but the edges of the wounded bark gradually approached each other under its shelter, and after several years met and united. By the time the wound was healed, the body of the tree above had become one-third larger than its body below it. And though several years have elapsed, the latter has not yet been able to overtake the former. The upper part of the tree, *rooted in the air*, vastly out grew the under, rooted in the earth. Therefore, it must have drawn either its *whole* or *chief* substance from the atmos-

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phere.* Indeed, between the bark and wood of most trees, and of the locust particularly, we find the chief channel of their juices; and the communication of these juices was utterly cut off, so that neither portion of the tree could supply the other.† If the part of the tree fed from the roots, extracted from the earth the food which the earth had previously extracted from the atmosphere; and if the earth was reimbursed gradually by the atmosphere, what is lost in feeding this part of the tree below the interdict to communication, as well as the great one above, it is considered as wholly obtained from the atmosphere, and might, on that supposition, be considered as a probable evidence in favour of the theory that vegetables get from the air and give to the earth."‡

Here, it would seem that the Colonel believes that the locust tree "wholly obtained from the atmosphere" the nutriment consumed by it. Whether he also believes that plants, while living, have not only the power "to get from the air," but also "to give to the earth" is not so clearly understood by me.

The sap rises from the root up through the vessels in the numerous layers or annual growths in the alburnum or sap-wood of a tree: therefore, the injury done to the locust by exposing the surface layer, or layers of the sap-wood to the air, *could not* prevent the ascent of the sap through the vessels into the alburnum, which lay too deep to be affected by the same cause. It is evident that injury must have been done by the ready admission of air through the wide openings in the rough surface bark of the locust, as these could not have been closed by the plaster bark.

In the back-woods it is the general practice to scalp off the bark, and often with the surface of the sap wood attached to it. This is done to mark, or as it generally is called, blaze the trees, on each side of the paths newly formed through our lonely forests, that the traveller may be directed in his course. We, therefore, have, by this and other operations in practice here, an opportunity of observing how nature heals the wounds made in trees. I have examined this process in various states, and on many a tree.

The new bark, like the new skin on wounds in animals, commences its growth round the edges of the whole wound, unless it has so happened that at any one part of the wound, the wood has been cut out deeper than in other parts of it. In this case, nature seems to find it much more difficult to spread, or even to com-

* Here, a mistaken theory, as too often happens, turns nature topsyturvy, or upside down. When we really see trees rooted in the air, as "the root is obviously the chief organ of nourishment," we may safely believe, as does colonel Taylor, that "vegetables extract their matter chiefly from the atmosphere."—See Sir H. Davy's Lectures on Agr. Chem. page 56.

† Here, this gentleman is certainly very much mistaken, as the girdling of timber in the back-woods, clearly demonstrates, that the great vascular system through which the principal part of the sap passes, is the vessels in the sap-wood, and in the bark of the tree. For an explanation of this, see my book on Vegetation and Manures.

‡ See Arator, pages 77, 78.

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mence spreading the new bark at those points; especially if the deep cut has been formed across the grain of the wood, and in healing this place, an unseemly scar is often formed; which I have been told is the principal cause of hollows formed in the bodies and limbs of trees. The air and water is let in by the openings in the imperfectly formed covering of bark, and gradually produces extensive fermentation and decay in the interior parts of the tree. Indeed I have in some places observed where the opening has been small, that the bark has grown over the rotten wood in it, which had been previously decayed by water lodging in the wound. The rotten wood thus inclosed, no question greatly facilitates the destruction of the interior parts of the tree.

The new bark commences its growth so far under the old as to form where neither the vessels in the old bark nor the texture of it has been injured, either by the action of the air, or any other thing. This often causes the new bark to commence forming so far under the old, that it cannot be seen unless the latter be stripped off. But here it is found firmly attached to the old bark, and each of them in unison, performing the functions of life. The new bark, in spreading itself over the wound, proceeds with its edges lapped or turned under similar to the edges of a piece of cloth lapped under to be felled. Those edges, so far as the eye can reach, do not adhere to the sap-wood underneath them. Beyond this point, as soon as the dried and dead surface of the alburnum has separated from the living wood underneath it, and the vacancy is filled up by a new growth of sap-wood, the new bark becomes firmly united to it, and the functions of life are performed by both of them. In this way the bark, in common cases, progresses until it meets and unites in or near the middle of the wound; thus the processes by which nature heals a wound in a tree, seem to be very similar to those employed by her to effect the same purpose in the animal economy. Here again, the analogy between plants and animals is seen.

I have before observed that the sap rises upwards from the roots by the vessels in the alburnum. It, however, "probably descends by the cortical vessels in the bark."* In the case of the locust, the further descent of it was arrested when it reached to where the bark had been stripped off. Here its journey downwards terminated, much in the same way as would have happened if nothing had obstructed the passage of it into the roots. But being propelled onward by the powerful principle of life in the plant, as it ever is when the temperature favours the circulation of the fluids, at this point it entered into the pores of the sap-wood which had been newly formed. For it could not pass into the injured pores in the dried and dead alburnum lying immediately underneath. The sap having by this means obtained an ascending direction, there can be

* See Sir H. Davy's Agr. Chem. page 64. And principally by the cortical vessels in contact with the alburnum, hence it is that the bark is more readily stripped off when the sap flows freely.

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no question but it continued to circulate upwards by the vessels in the alburnum, and downwards by the transporting vessels in the bark, until nature had prepared, and also applied, the various matters contained in it, to all the purposes of life throughout the whole structure of the tree, above that part of it where the bark had been stripped off. Hence it happened, that the part of the body above the wound increased much faster in size than did the part of the body below it. It is also evident that Colonel Taylor's theory cannot be correct, for if it were, as he says, to wit, that "neither portion of the tree could supply the other," it must have dwindled, and sooner or later died, as does every tree that has been effectually girdled. It is also obvious, that if this gentleman's theory were right, every girdled tree in the back-woods would possess the same power to form and increase its structure above the girdled part of it, just the same as if no attempt had been made to destroy it, at least until the water from rain, &c. lodging in where the girdle had been formed, produced a general decay at this point, and caused the tree to break off, and fall to the ground.

To cast further light on this subject, I beg leave to make some observations on what Sir H. Davy has said of wounds in the bark of trees. He tells us, "When new bark is formed to supply the place of a ring that has been stripped off, it first makes its appearance upon the upper edge of the wound, and spreads slowly downwards, and no new matter appears from below rising upwards. In the summer 1804 I examined some elms;* the bark of many of them had been stripped off a foot square; in most of the wounds the formation of the new cortical layers was from above; but in two instances there had been very distinctly a formation of bark towards the lower edge. I was at first very much surprised at this appearance so contradictory to the general opinion, but, on passing the point of a knife along the surface of the alburnum, from below upwards, I found that a part of the cortical layer, which was of the colour of the alburnum had remained communicating with the upper edge of the wound, and that the new bark had formed from this layer."†

Facts are, however, very contrary to this in the back-woods. Here we see even when a part of the sap-wood has been removed with the bark, consequently every vestige of a cortical layer removed, that in common, the new bark grows out as readily from the lower edge, as from the upper edge of the wound, and in general it is sooner seen growing out from under the bark adjoining the sides of the wound, than from that above or below it. The cause of this seems to be, that the old bark both below and above the wound is cut across the grain of it, therefore cracks open, and also separates more freely from the sap-wood by the action of the sun and air. By this means

* He says, however, that he did not examine them after this, if he had, his erroneous theory might not have been published. The process is slow, consequently cannot be understood but by due attention to the progress of it.

† See his Agr. Chem. page 243.

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the economy of the tubes and vessels contained in it, is more extensively injured. Hence it is, that when the tubes are thus injured, the new bark commences growing further in, where they and the vessels in the old remain unhurt. How indeed could it be otherwise, when nothing can be more evident, than that the sap in trees, as well as in herbaceous plants, circulates through the different parts of their system as freely as the blood circulates through the different parts of animal systems, and to effect the same purposes.

That a free circulation of sap exists between the sap-wood and bark of a tree, is evident from an experiment detailed by Sir Humphrey. He says, "It would appear from the late observations of M. Palisot de Beauvois, that the sap may be transferred to the bark, so as to exert its nutritive functions, independent of any general system of circulation. That gentleman separated different portions of bark from the rest of the bark in several trees, and found that in most instances, the separated bark grew in the same manner as the bark in its natural state. The experiment was tried with the most success on the lime tree, the maple, and the lilach; the layers of the bark were removed in August 1810, and in the spring of the next year, in the case of the maple, and lilach, small annual shoots were produced in the parts where the bark was insulated."*

So well persuaded does Sir H. seem to be of the validity of this fact, that he has given a plate in his book representing the trunk of the willow, with the insulated piece of bark, and the annual shoot growing out from it, with the leaves upon it, and also the cavities formed by running the bark from every side of it, by which means it stood entirely detached from the cortical system of the tree. Still this gentleman says in another part of his book, "It is impossible to conceive a free lateral circulation between the absorbent vessels of the alburnum in the roots, and the transporting or carrying vessels in the bark; for if such a communication existed, there is no reason why the sap should not rise through the bark as well as through the alburnum; for the same physical powers would then operate on both."†

Now it is evident from the experiment made by the insulated bark growing on the trunk of the willow, that in this part of a tree, there is a circulation of the fluids between the bark and alburnum. It would also appear, that this circulation must be in general considerable, or it would not have produced the effect (which has been described) in the small piece of insulated bark, wounded very severely on every side of it, and in that way which lay the wounds continually and openly exposed to the injurious influence of the sun and air. How much more powerfully then must be the lateral circulation of the sap between the bark and the alburnum, when employed where the economy of the bark had not been thus exten-

* See his Book on Agr. Chem. page 59. † Idem, page 249.

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sively injured. The experiments detailed in my book on Manures and Vegetation have proved beyond the reach of controversy, that the heart-wood of a tree is alive, and that the growths in it, which had been made on the outside surface of the sap-wood, as the tree increased in size, were also, until the plant had attained its full growth, annually increasing in size, and this too after they had been previously compressed into solid heart-wood, by the pressure of the increased number of the annual growths of the alburnum: consequently a free lateral circulation of the fluids must exist between the pith, heart-wood, alburnum and bark of a tree.

We also find, that from the most interior parts, not only of herbaceous plants, but also of a tree more than five hundred years *old*, the juices which supply nutritious matters to the alburnum, may be extracted as pure and unaltered as they are found near the surface of the plant. This, also, seems to prove a free lateral circulation of the fluids from the surface to the centre of a plant.

If the facts above related, with many more enumerated in my book on Manures and Vegetation, be duly appreciated, it would appear that nature has formed in plants, as she has done in *animals*, an extensively diversified system of tubes and vessels, by which the sap is regularly circulated throughout the whole system of the plant, and that this mechanism has been so constructed and ordered, that no single one or more of those tubes and vessels intrude upon, or oppose the functions of any other one or more of them, and that though in some instances, they may seem to act separately, they at the same time act in perfect unison with each other.

Sir Humphrey says, "In the leaves much of the water of the sap is evaporated; it is combined with new principles, and fitted for its organizing functions, and probably passes, in its prepared state, from the extreme tubes of the alburnum into the ramifications of the cortical tubes, and descends through the bark. Now, here I would ask, why may not this circulation be as readily kept up, or perpetuated, by the sap after it has descended from the top of the tree into the roots, by the carrying vessels in the bark, by passing from the extreme tubes of those carrying vessels into the tubes of the alburnum in the roots, and from thence ascend through the pores in this wood, to the extreme top of the tree. It does not appear that nature has placed any obstacle in the way of the perpetual circulation of the sap, while the temperature favours the process; particularly as the organization of the radical fibres and tubes must be very similar to that of buds and leaves. For Sir Humphrey says, "*By* burying the branches of certain trees in the soil and elevating the roots in the atmosphere, there is, as it were, an inversion of the functions, the roots produce buds and leaves and the branches shoot out into radical fibres and tubes. This experiment was made by Woodward on the willow, and has been repeated by a number of physiologists."*

* See his Lec. on Agr. Chem. page 56.

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Be the circulation of the fluids in a tree, however, carried on as it may, it is highly probable that when the economy of plants is better understood, it will be found very similar to that of the circulation of the blood in animals, as no other seems to be well calculated effectually to prepare and apply the matters contained in the sap.

But, to return to Colonel Taylor's theories, from which it would appear, I have wandered further than I had intended. He says, "It is unnecessary to consider whether the animal and vegetable manure I have treated of, ought to be ranked among the auxiliaries of the atmospherical, or the atmospherical degraded into an auxiliary of theirs. For my part, if I was driven to the alternative of rejecting one, I should not hesitate to cling to the atmospherical, as the matrix of all;* or rather to that portion of it within our reach by other channels than those of farm yard animals."† And again, "It is yet a question, whether the earth is enriched by any species of manure, except the vegetable or atmospherical, and experiments have hitherto leaned towards the negative."‡ "The great object of making and applying the manure arising from litter of every kind, and the dung of animals, is to avoid the loss by evaporation."§

Those sentiments must surprise the plain, practical, observing farmer, whose opinions have not been perverted by erroneous theories; especially as the Colonel, four years after these opinions were propagated by him, and after he had effected an improvement, by his very extensive system of economical management, (which must, or at least ought, to astonish the farming world,) would seem to hold out the same ideas, very little altered or ameliorated by the highly interesting facts evidently unfolded, as the great improvements made by him rapidly progressed.

He says, "The foregoing essays having been written several years past, subsequent experience has made some change in a few of the author's opinions. Those in relation to the essential article of manure are stated in this note.

"The extent of surface now manured upon the same farm, by a more careful employment of the same resources, has so far exceeded his expectations, as to have transferred his preference as means of improving the soil from enclosing to manuring, without, however, lessening the value of the former, in his opinion. A field of two hundred acres, aided by both, produced last year, a crop of Indian corn, averaging fifty bushels an acre; and another of eighty, aided only by enclosing and gypsum, a crop of twenty-five. The first being nearly double, and the second one-third beyond their respec-

* If Colonel Taylor had reflected before he advanced this very inconsiderate theory, he would have seen that the atmosphere is indebted to the gaseous effluvia constantly emitted from dead and living animal and vegetable substances, for all the nutritive matters found in it, consequently the food for plants does not originate in the atmosphere.

† See Arator, page 75. ‡ Idem, page 52. § Idem, page 62.

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tive products when last in culture. Under a diminution of the stocks quoted, the surface manured last year, exceeded one hundred acres, and will this year extend to one hundred and thirty. It is contemplated to extend it, until it reaches annually a space sufficient for the whole corn crop of the farm. The regular increase of crops furnishes additional vegetable matter; the chief basis of this rapid improvement."*

No question but the Colonel will, if he should live and prosper, extend his manuring as far as, or even much farther than, he contemplated. He will certainly find, however, that this invaluable object cannot be effected, without a proportionable increase of the live stock kept on the farm. Though he now considers "the vegetable matter the chief basis of this rapid improvement," his enterprising mind will sooner or later, but as I believe very soon, discover that dried straw, in which practice, as well as chemistry, determines there is but little nutritive matter for cattle, and of consequence as little food for plants, united with cornstalks, dried as his are, by standing by far too long exposed singly in the field, can afford but little nutritive matters for plants. In the space between the two first joints of the cornstalk, much saccharine matter is stored up in the pith. The Colonel's mules and horses may obtain considerable nutriment by dexterously opening the stalks at these points, and taking out and eating the pith. When the stalks have been well saved by gathering them early, and setting them up in well formed heaps, calculated to run off the water from rains, &c. especially if they had been gathered by the too tedious practice of pulling them up by the roots, much of the saccharine matter is preserved in the pith. I very well remember, that after a quantity of cornstalks which had been gathered by pulling them up by the roots, were carried into the cattle yard, of being much amused by observing about thirty horses, which had been taken in to winter, abandon their hay, and each one of them, as if previously taught by long practice, dexterously employed in extracting and eating the pith contained in the space between the two first joints of the stalk. The husk, which envelopes the ear, is, when the fodder of the corn plant has been well saved, very nutritious food for cattle; but by the usual tedious and very expensive practice of gathering and securing fodder the husk is left hanging on the stalk in the field, where, by exposure, far the greater part of the nutritive matters contained in it are scattered in the air. However, so much still remains in the thick leaves by which it is formed, that hungry cattle will eat, and may be kept alive on it.

The Colonel should, however, have recollected, that after the pith had been extracted by his mules and horses, and the husk eaten by his cattle, the meagre remains of the cornstalks could have afforded but little nutriment for plants; and that the chief use of them must have been, to imbibe, and carry out in them to the field,

* See note, page 207.

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the rich juices found in the cattle yard. This mode of using them never fails to increase their value manifold.

It was, therefore, to the animal matters imbibed by the stalks, and dry straw with which his cattle were littered, together with the small quantity of dung dropped by them, while feeding in the yards, to which the Colonel was indebted for the greater part by far of the increased improvement made by him, where his long manure was spread; notwithstanding he says, in the note now under consideration, "We shall never succeed to a great extent, if we consider animal manure in any other light than a kind of sugar to sweeten the copious repasts of vegetable, with which we ought to feed the earth.* It may also mingle with vegetable matter, dispose the mass at particular periods of its putrescency to extract salts from the atmosphere; but however useful it may be, the epithet *animal* is only to be admitted connected with a recollection of its origin. This is vegetable matter, of which animal manure is only a remnant, having undergone one or two secretions, and the diminution arising from animal perspiration. Vegetable matter, therefore, is the visible origin of manure; if atmosphere is its source, that can only be reduced to a visible substance by vegetable instrumentality."†

There is certainly a considerable part of this quotation which I cannot understand, so as to be able to make any useful remarks on it. It would seem, however, by that part of it which I can comprehend, as if the Colonel, after he had ploughed under his long manure, was, by his theory, naturally led, in idea, up into the atmosphere in search of substances, which the animal matters, in conjunction with the dried vegetable substances, might extract from thence. For it would appear, from this and other parts of his book, that he considers animal manure of little consequence as food for plants. He, however, thinks that, in conjunction with vegetable substances, it might extract salts from the atmosphere. It cannot be questioned that the long manure, if it had been favourably situated, was well calculated to gather nitrous impregnations from the atmosphere; still it would seem, that the depth at which it was covered under the soil was by no means calculated to favour the project. If those salts, however, had been plentifully gathered by it, they contain no nutriment for plants: consequently

* But here I would ask whether it be possible to believe, that after this gentleman's cattle had stripped off the dried husk, and his mules and horses removed and consumed the pith, as has been explained, the meagre remainder of the cornstalks can furnish "a copious repast for plants," when animals, who live on the same food as plants do, would actually soon starve to death on such provision, even if the griping pains of extreme hunger should induce them to eat it. As plants live on the same food as animals we have a sure criterion, by which we may readily determine the value of such substances as are eaten by cattle, when they are used either green or dry for manure. For in due proportion as these substances, when used as manure, are found more or less nutritive, when consumed by cattle, in like proportion will they be found more or less nutritive for plants.

† See same note.

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could act in no other way than by the introduction of more moisture, and stimulating fertility, by the hasty and unnatural decomposition of the nutritive matters contained in the soil and manure. But as it seems most probable that those salts were not gathered, at least to any material extent, it would appear most likely that little or no good was derived from them, at least in the way that this gentleman has pointed out.

It would seem, however, that notwithstanding the Colonel's theories are evidently very erroneous, they did no injury whatever, so far as his long manure was concerned. The plants derived just the same nutriment from it, as they would have done if his theories had been perfectly correct.

But it was otherwise in his practice of turning a clover lay for corn, as this was not done until the vegetation, except the roots, which yet remained green and well stored with vegetable matter, was still more effectually stripped of the rich nutritive matters, which they abundantly contained while green, than was either the straw or cornstalks, previously to their being applied as litter for the cattle. This will, however, be more particularly explained after I have made further observation on what this gentleman says of animal manures.

He tells us in the same note, now under consideration, when speaking of vegetable manure, "Its vast superiority over every other species of manure, designates it as the basis of agriculture. Applied in green bushes, it is much more beneficial in curing galled declivities, than animal manure. I use it with great advantage for that purpose, and also for manuring level land."

Animal manure would soon be washed out from galled declivities, or gullies, as this gentleman elsewhere calls them; therefore, in such places, green bushes may be much more profitably employed. They naturally arrest at least a part of the soil washed into them, and with it, the enriching matters contained in the part arrested. By this means the gullies are eventually filled, and commonly with a deep soil well stored with nutriment. Colonel Taylor is certainly justly entitled to great praise for his prompt attention to gullies, which are but too generally neglected, and much land ruined by them, and also for the economical practice he has adopted of making the gullies productive, while time, aided by his very ingenious contrivances, is filling them up; likewise for doing this by employing nothing but green bushes and small brushwood, as manure for the crops, substances which are but too generally burned, or otherwise destroyed, so as to answer but little, if any, valuable purpose, by too many cultivators. Still, no person whose judgment has not been greatly blinded by erroneous theories, could readily believe, that green bushes, or even green clover, or any other vegetable manure known to, or used by us, is any thing like as nutritive as animal matters are when used as food for plants. Neither are there any vegetable matters by which the soil can be so soon, or as highly enriched, as by animal substances.

Animal matters, when applied for the growth of plants, are the

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most powerful of all manures, without making any reference to the salts which Colonel Taylor seems to think are gathered from the atmosphere by these matters, in conjunction with vegetable substances, or indeed without referring to any other property which they either really have, or may be supposed to possess, but simply that of the food for plants actually existing in them.

This gentleman might have clearly seen this from the vast disproportion, in point of produce, between the crop of corn grown on the clover lay, and that on the grounds which had been manured by litter, slightly intermixed with the dung made by his cattle, and also saturated with the rich juices gathered in the cattle yard. The quantity was doubled in the latter case, and if the manure applied had been as highly enriched, as it would have been if cattle, in due proportion to the litter employed, had been fed and constantly kept in the yard during the season for feeding dry fodder, the crop would have yielded three or four times as much corn to the acre, as that grown on the clover lay without dung. The richest lands that are to be found will yield much more Indian corn, or a far greater crop of any other plant known to me, which is not readily injured by much nutriment, if a rich coat of stable manure be spread over the soil, and ploughed in for the crop. The cause of this is as evident as that of any other fact, and seems to have been well known *practically* to Colonel Taylor. He says in his observations on the impoverished state of the lands in Virginia, and when, it would appear, his theories did not blind his better judgment, that "to conceal from ourselves a disagreeable truth, we must resort to the delusion, that tobacco requires new or fresh land; whereas every one acquainted with the plant, knows that its *quantity* and *quality*, as is the case with *most*, or *all* other *plants*, are *both greatly improved* by *manured land*, the fertility of which has been artificially improved."* Thus it frequently happens, that we may see the wisdom that governs a man's practice, if it be good, when his theories are immediately opposed to reason and practical observation.

The reason why lands, recently cleared from their wood, are not so productive as grounds which have been judiciously managed by man, is obvious. Notwithstanding nature employs means, by which a vast body of animal matter is generated, and is also careful to spread this matter over the surface of the soil, so that it may be intimately blended with the vegetable matters contained in it; the quantity of animal matter so gathered and spread by her, falls very far short of that which may be gathered and spread where man presides, if he acts judiciously. The number of large animals that may, in this case, be profitably fed by that part of the vegetation grown on the grounds which he can readily spare, afford a large quantity of dung. Hence it is, that when man wisely co-operates with nature, the soil is much more highly improved by this increase of animal matter; and there animal life may be propagated and supported to the utmost possible extent.

* See Arator, page 8.

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CHAPTER LII.

Remarks on Colonel Taylor's practice. To him belongs the honour of forming a system of management, calculated to promote the agriculture, prosperity, and wealth of Virginia.

My observations on Colonel Taylor's theories, will, I trust, be generally useful. Those, however, made in this chapter, on his practice, will be more important to the circumscribed farmer, and it is him that I more especially have laboured to instruct, by referring to the opinions and practice of this truly great *practical* agriculturist.

The Colonel observes, that "deep ploughing upon a naked and poor soil, by which a caput mortuum is brought to the surface, has frequently proved pernicious. This has been owing to a variety of causes, but among them, the preservation of a flat surface, though least suspected, has probably been the most operative. The simple process of burying under a steril tegument, the little strength of the land, neither promises nor performs much; but the disappointment of hopes really forlorn, frequently causes us to abandon effort, and embrace despair. By the system of these essays, enclosing,* manuring, and high narrow ridges, are combined with deep ploughing. The two first replenish the earth with a large stock of vegetable matter, and the last has the effect of collecting the existing soil in the centre of the ridge, and depositing the steril on the two sides, there to remain for above three years, exposed to the action of the atmosphere. Thus all the effects of deep ploughing are avoided. Instead of a naked surface, it is applied to one largely replenished with vegetable matter. Instead of forcing the soil and substratum into a topsyturvy position, it collects and doubles the first for a present crop, and provides for the amelioration of the other, for a future one. It deepens and fructifies the soil, whilst it makes the best provision for present profit. For the reader will observe that I am speaking of poor lands, whose soil requires doubling for present subsistence, and improving for future comfort; and not of those soils which cannot be pierced by the plough. By deep ploughing, I always mean the best to be performed by four horses in a plough."†

I do not understand, by what Colonel Taylor has written, how his grounds are ploughed, so that "instead of forcing the soil and

* This is the term which Col. Taylor employs when vegetable substances are ploughed under.

† See Arator, page 110.

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substratum into a topsyturvy position, it collects the first for a present crop, and provides for the amelioration of the other for a future one."

It is, however, to be readily understood that when farm yard manure is applied for his corn crop, the dried weatherbeaten tops of the clover are turned under in the winter, and as I understand him, eight inches deep,* by four good horses in a plough; that after the farm yard manure has been spread in the spring, the ground is again ploughed by four horses hitched to a plough. It would seem that this last ploughing is well calculated to admit the "thief evaporation," and also expose a surface well calculated to encourage the growth of grass and weeds.

From what this gentleman has written on ploughing in the dried vegetation, when farm yard manure is not used, I cannot understand whether the grounds are or are not ploughed twice, previously to planting the corn. The "thief evaporation," is, however, again let in to do very extensive mischief, notwithstanding the Colonel is so very anxious to exclude him from his system of management.† So great indeed is the injury done in this case, that nothing like the same amount of nutritive matter could possibly exist in the tops of the clover, as exists in the same weight of dry straw. This, we all know, affords but little nutriment for cattle; of consequence but little food for plants. To illustrate this, it requires more ground to furnish as much hay as will fully feed an ox six months, than it would to yield as much grass, to be cut with a scythe, as would feed him plentifully for the same time. Hay can be seldom so well saved, as to fatten an ox. Grass, however, when cut and fed green, will certainly fatten him, unless his previous habits have been such, as to prejudice him much against eating it freely when given to him in this way. It, therefore, appears that the "thief evaporation" steals much of the nutriment contained in grass, in making it into hay; especially if the weather and the skill of the farmer do not favour the process. If, however, the grass happens to be much exposed to rain, especially at a time very unfavourable to the process, "the thief evaporation" steals so much of the nutritive matter contained in it, that it is often no better, and sometimes inferior to straw. As clover, however, is much earlier and more severely injured by frost than are the speargrasses, if a part of the nutritive matters washed out of it by rain was not secured by sinking into the soil, "the thief evaporation" would steal nearly the whole of the nutriment which was originally contained in the grass, previously to its being ploughed under in the winter; consequently,

* This gentleman's essays were first published in a newspaper, &c. consequently he was compelled to be brief. This seems to be the cause why, even in plain practical cases, he is not readily understood.

† Every cultivator should be quite as anxious as is the Colonel to exclude this thief. In doing this, however, he should be careful that by the means employed to exclude one robber, two or three still more destructive thieves are not let in.

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notwithstanding the body of vegetable matter had been greatly increased, by remaining on the grounds throughout the spring, summer and a part of the fall, "the thief evaporation" had stolen so much of the nutriment which had existed in it while green, that there is no man who admits that animal and vegetable matters alone, furnish food for plants and animals, who (if not misled by erroneous theories,) would not believe that if the Colonel had either judiciously pastured the first crop of the last year's clover, or made it into hay, that a full grown second crop of this grass turned under the soil in the fall, while it was green and well stored with nutritive matters, would have furnished vastly more food for plants, than did the whole dried, weatherbeaten substances employed by him.

By applying the second crop of clover for manure, he might have augmented his live stock from the food obtained by the proper use of the first, and in this way increased the means of more rapid improvement, with but little perceptible expense. Provided the additional live stock were gradually reared on the farm.

The Colonel seems to think that dried vegetation may be more usefully employed as manure than green. He says, "By ploughing in the vegetable succulent, we stop the process for extracting, elaborating, and condensing atmospherical manure, and chiefly bury water, liable to the laws of evaporation, demonstrated in the case of rain, the richest, but most shortlived of every species of manure. On the contrary, by suffering the vegetable to acquire its most solid form, it will extract more manure from the atmosphere, and this manure will be retained vastly longer by the earth."*

This gentleman should have informed us how "we stop the process for extracting, elaborating and condensing atmospherical manure, by ploughing in the vegetable succulent late in the fall;" also, how happens it that, "by suffering the vegetable to acquire its most solid form, it will extract more manure from the atmosphere, and this manure will be retained vastly longer by the earth."

I do not know whether the Colonel here means, as in the case of his long manure, that the vegetable extracts more manure from the atmosphere, after it is dead and buried under the soil, or whether he believes it is extracted while it is living, and applied in it after it is dead. In either case, however, it is as evident as any other thing can well be, that what he says cannot happen.

He should likewise have explained how "rain water" can "be the richest but most shortlived of every species of manure;" especially, as chemists tell us, that very little nutritious matter is to be found in it.

The true state of the case is simply this, green vegetables soon ferment after they are ploughed under the soil. The water contained in them is, therefore, quickly evaporated. The nutriment furnished by them, however, is not more subject to evaporate than is that from any other enriching manure. The quantity of woody

* See Arator, pages 57, 58.

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fibre in the fully grown green vegetable, is equal to that in the dry. But it ferments more freely than dried vegetable woody fibre; particularly if the latter has not been excited to an early fermentation by being well saturated with rich matters from the cattle yard or elsewhere. It is, however, the particular property of green as well as dry woody fibre, to keep the soil much moister in a dry time, whether it be clay or sand. The processes by which this is done are highly interesting, and have before been fully explained.

I have before clearly shown why a thin soil should not be deep ploughed, and that it is more highly improved, and its products greatly increased, by a contrary practice.* Likewise, why but one ploughing is far better than more for a crop of maize, or any other fallow crop, and why the ground should not be ploughed for the small grain following any fallow crop. Colonel Taylor's grounds seem to have been formerly very poor; but as it is to be expected, that his superior talents had ameliorated them as far as a bad system of husbandry would admit this to be done, previously to the commencement of his present highly improved system of farming, it is believed that ploughing to six inches deep might be safely practised on such grounds. It is also thought, that this would have been far more profitable in his practice than eight inches, which seems to be the depth employed by him; particularly as his long manure appears to have had but a scanty proportion of dung incorporated with it.† As one ploughing would have been far better than two for his corn crop, and it seems probable that he also ploughed at least once for the wheat following it, he might, (with great improvement to his crops and his soil,) have saved a very great deal of labour; especially as two horses in the place of four hitched to each plough would have been sufficient to execute the work.

The Colonel is certainly much mistaken in attributing to ridges, as formed by him, a peculiar power to secure moisture. They are as much opposed to this as any one thing can well be to another, being exactly calculated to produce artificial droughts. A capital blunder, which has been before explained, induced me to plant my corn on ridges; and, as the error was not soon enough discovered, the practice was by far too long continued by me. My grounds were manured by fresh long manure, principally composed of cornstalks and other dried vegetable substances; but, from the product of the crops, it would appear, that these dried substances had more dung mixed with them than was employed in his practice. It would also seem, that my ridges were not as high as his, for my ploughing was but six inches deep. As the causes, however, which produced the injurious effects arising from ridges in my practice have

* Practical observation seems to have determined, that the poorest soil that will pay the farmer for cultivating it, should not be ploughed less than four inches deep, taking care, however, in the execution of this work, to be under in preference to being over this depth.

† When but little enriching matter is employed in a thin soil, and the ploughing is deep, the fermentation is seldom as powerful as it ought to be.

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been carefully explained before, it would be useless to enumerate them again.

This gentleman forms his furrows for planting along the middle of the ridge by making a deep and wide furrow with a trowel, hoe-plough, and two mould boards. This wide and deep furrow seems to be useful in his practice. By planting the seed so far below the top of the ridge, the finger roots, which have been formed to dip deep, will grow further into the ground. The plants, therefore, will be better secured from the effects of drought by this mode of management. This open furrow will also better preserve the moisture arising from the rain falling into it than would the round of a ridge, until it is filled up by cultivation. In case, however, of planting on a level surface, or on a ridge formed in a retentive soil as it ought to be, (to wit, with no more rotundity than is absolutely necessary to run off into the water furrows, any excess of moisture which might prove injurious to the plants,) a deep and wide furrow for planting would be very injurious, except in a new soil, which never seems to be so retentive of moisture as to require ridging, but where so much dried and partly decayed hard vegetable substances prevail as to render it necessary to make the furrow deep enough to plant the seed on the more solid earth or soil, and to cover it by the same material as has been before described. The cause of the injury generally done by planting in a very deep furrow, is, that filling up the furrow in the course of cultivation compels the plants to form a new set of lateral roots at the expense of those already formed. This diverts the efforts of nature from the improvement of the top of the plant. The injury done to the economy of plants by this and the several other truly savage practices in too general use, have been before explained.

Colonel Taylor, in page 101, says, when describing his mode of cultivation, "A deep furrow is run on each side of the corn by a large plough, drawn by two horses, with a mould board, causing the earth thrown out of it to meet at the corn, though the furrow is a foot from it." In page 106, he informs us, "that this furrow is formed in June;" and says, "by this time the corn is from eight to twenty-four inches high. At this juncture, the deep furrow on each side of it being run, narrows the ridge for about eight days, until it is again widened by the middle furrow; and that space will suffice to give the corn roots the longitudinal direction which shields them against all injury. This furrow being bestowed on it whilst it is young, and its roots short, and being run near a foot from it, the roots of the corn, from this mode of culture, wholly escape injury, and the effect of drought being thus diminished, its product is increased."

If the corn plant be pulled up from an open, free soil when it is not more than three inches high, the lateral root will be found about twelve inches long, beside the smaller fibres left in the ground by this rude operation. If Colonel Taylor had examined

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the lateral roots of his corn when the plant was only twenty-four inches high, or even before it had attained this height, he would have found that they had extended as far as this very deep furrow bounding each side of the ridge, would permit them to run. This being the case, the lateral roots were all cut off, by forming the deep furrow within one foot of his plants, except such roots as had taken their natural course lengthwise the ridges. Of consequence the crop was much injured by this inconsiderate operation.

This gentleman seems to believe he had given the roots of the corn plant a longitudinal direction by the wide furrow which he made about one foot from each side of his plants. But here I would ask, could he, or any other person, rationally expect any possible advantage by diverting nature from her usual course, and by this means confining the roots into a narrower compass? Does not reason as well as practical observation, dictate, that the more extensive the pasture provided for the roots of plants, and the less they are diverted from their natural course, the more luxuriant and productive they will be?

The lateral roots of plants, however, are not to be diverted from the course nature has taught them to take, by forming a deep furrow near to the plant, unless the bottom of the furrow so formed, be frequently disturbed, or cut up, by some instrument calculated to cut off the new roots, (which will form from the stubs from which the former set of roots were separated,) as effectually as did Colonel Taylor, by forming the deep furrows, cut off the roots from his plants.

The lateral roots of maize not only cross such wide and deep furrows unobserved by the cultivator, unless he traces their track under the cover of the ground, but, after they have crossed them, proceed up into that part of the soil where nature had appointed them to grow: self-preservation seems to compel them to do this, as they cannot live if buried too deep under the surface.

Having pointed out, as I believe, the errors in Colonel Taylor's theories, and how his practice may be improved, I will now make some remarks on the very superior excellence and economy of the latter. The most important part of it is, the discovery he has made, and proved by actual practice beyond the reach of controversy, that grounds which had not been more reduced than his were by a bad system of husbandry previously to the commencement of his new practice, may, with the aid of no other manure but gypsum, and the clover growing on them, be so managed as to yield a crop of corn, followed by a crop of wheat, if on this last crop clover seed be sown, to be continued but two years, and the grass of the first year be suffered to rot on the ground, and that of the second year be turned under, even when dry, for the corn which will commence the ensuing round of crops. By this very cheap and simple practice, he has discovered that the product of the grain and grass crops, as well as the fertility of the soil, have been regularly increased every round of crops, or in the course of every

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four years. Many have grown, and ploughed in clover, and some have suffered it to rot on the soil; but, it seems, that it is only to Colonel Taylor that the honour is justly due, of discovering and reducing into regular practice, the highly important system of management briefly described above.

The free white populationof Virginia is so inconsiderable in proportion to the cleared land, that the owners of the grounds could not get tenants with sufficient capital to cultivate the soil, so as to promise any improvement, were the larger farms to be divided into small ones. This seems to compel the owners of the land to cultivate it themselves, or to subject it to still greater injury than has yet been inflicted on it. The labour, however, was so much increased by making the farm offices the centre of motion when the farm was very large, that but little profit was to be expected, especially from poor grounds, unless this evil could be at least in part removed.

This, it would appear, could not escape Colonel Taylor's extensive talents, notwithstanding all that Arthur Young, and other visionary theorists had published to the contrary. He says, " the annual farm pen for cattle is indispensable,* as being a vast saving on European custom of stationary cow-houses. A. Young is, I think, of opinion, that twelve hundred acres is the size of a farm best adapted for the economy of labour. Suppose two hundred and fifty acres of this farm to be annually ploughed and fifty manured. If the manuring is commenced around a station for raising manure, in four years this station is insulated in the midst of two hundred acres of manured land, leaving it about six hundred yards distant from the nearest of the unmanured land, which distance increases as the manuring is extended from that minimum to its maximum, namely, the distance from the centre to the verge of an area of one thousand two hundred acres. Hence the expense of carrying in the litter, and carrying out the manure, will presently become so enormous, as to drive the farmer into the ancient ruinous and abandoned custom of infield and outfield, or that of highly improving a spot, around his house, and greatly impoverishing the rest of his farm."†

The evils enumerated by Colonel Taylor would have been effected ere this in Britain, had the support of Mr. Young's economical system, as he very inconsiderately calls it, depended solely on the capital and management of the mammoth farmers in England. The long continuance of the late war, however, raised and kept the price of the products of the soil so very high, that while it continued, the enormous extra expense arising from this, and various other causes equally destructive to the simple, but wise economy of agriculture, was not felt by the mammoth farmers. And parliament since the war ceased, propped the tottering, visionary project, by large bounties, or what is in effect the same thing, by prohibiting the

* It actually is so, if great profit is to be rationally expected from Colonel Taylor's invaluable system of management.

† See Arator, page 68.

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importation of the products of the soil, until after the price of them had risen above that at which the British farmer could grow them, without ruin to himself.

The complicated, expensive, and ruinous system of management, practised in Britain, may for a time astonish and mislead those who are captivated by show and parade, but must sooner or later fall, or the manufactories of that country will languish and dwindle, or her artisans be compelled to emigrate to countries, where bread, and the other necessaries of life may be had at about half the price which generally obtains in England.

But to come still nearer to the point; if extensive farms have been beneficial to Great Britain, how happens it, that Sir John Sinclair tells us, that "For above seventy years at the commencement of the last century, we fed ourselves, though the price of grain was so low, as greatly to promote population, a sufficient practical refutation of the several visionary doctrines which have been promulgated on that subject."* Also that "throughout the greater part of England, until about the commencement of the American war, rents were low. The landlord and the tenant jogged on together, the one satisfied with an inferior rent, and the other with his share of a moderate produce."† Likewise, that "Mr. Middleton gives the estimate of the value of corn in Middlesex, about the year 1796, before the late great increase in the price of grain." He in this estimate "rates wheat at an average for many years at five shillings and six pence,‡ (or one dollar twenty-two cents) per bushel."

Here I would ask, whether it would not have been far better, if the landlord and tenant, or small farmer as he is now called, had continued to jog on together in the good old way? the one using the superior means possessed by him of obtaining information, in instructing the other in the genuine principles of rural economy. If in doing this, the landlord had formed a small portion of his grounds, without ostentation or parade, raising annually the best crops the soil was capable of producing, and with the least possible expense, the agriculture of England would, ere this, have become nearly, or perhaps equal to that of Flanders and Brabant. Sir John says, when speaking of the small farms lying near to the large towns in Scotland, hence it is, that in Flanders, which is full of large towns and villages, the farms are small."§

Now how happened it that Flanders is filled with large towns and villages? and how is this population supported, if Sir John be correct in saying, in another part of his book, "It is only by the means of large farms, that great towns or populous districts can be supplied in sufficient quantities, with grain and butcher's meat?"‖ This gentleman also again says, "It is, however, *known by experience*, that it is *impossible* that any country can be *improved* where small farms prevail."¶

* See his book on the Systems of Husbandry in Scotland, vol. ii. page 96.
† Idem, pages 84, 85. ‡ Idem, page 383. § Idem, p. 133.
‖ Idem, p. 151. ¶ Idem, p. 162.

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It is evident, however, he might have known that the reverse of this very inconsiderate theory is true, if his superior judgment had not been led astray by the favourite system of the age.

In proof of this, I will copy some parts of a letter written to Sir John by Mr. Gillet, directeur des affaires publiques à Bruxelles, dated the 27th December, 1801. To wit.

"The important services you have rendered to the agriculture of England, will, I hope, sufficiently apologise for the liberty I take in addressing you on this subject, without having the honour of being known to you.

"I have examined, with attention, the situation of agriculture in most countries in Europe, and do not hesitate to affirm, that it is no where so well understood and practised as in the Low Countries. I do not except my native country, England, though I am ready to admit that she is as much advanced in this important science beyond France as the Low Countries are beyond England.

"This will not surprise you, Sir, when you consider that while the fortunes of England and France were divided between agriculture, industry, colonization and external commerce, those of the Low Countries, were principally employed in the advancement of agriculture alone, by *establishing small* farms.

"This system has succeeded admirably well in Flanders and Brabant, where land is every where in the highest state of cultivation, and offers a wonderful contrast with the situation in the Liege country, county of Namur, and in the province of Hainault, which confines (bounds) Flanders and Brabant. There the system of large farms, is still in common practice, and very little progress has been made within fifty years. The vast disproportion in the product of those different provinces, when compared with that of Flanders and Brabant, offers a very strong argument against the system of large farms; and I urge this point with more confidence, as it is the result of experience and attentive observation, and because I learn, with regret, that this mode is very predominant in most parts of England.

"The influence which you have acquired in your country, by your knowledge in this science, and the warm interest I take in every thing that can contribute to the prosperity of my native country, engages me to request you to fix your attention on the Low Countries, where you will find many methods new and economical, that may be beneficially employed in England.

"It is an error into which many have fallen, for want of observation and a knowledge of the interior of the country, to believe that the soil of the Low Countries was originally good. It is the almost *incredible industry* of the *peasantry* in Flanders and a part of Brabant which has rendered the soil so productive. The Pays de Waes a *prodigy of art*, was forty years ago a bruyere, *a heath* or *waste*. It is now perhaps the richest province in the world.*"

* See Sir John's book on Systems of Husb. in Scotland, vol. ii. Appendix, pages 189, 190, 191.

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Now it would appear that this "prodigy of art" has been achieved by the superior talents and indefatigable industry of peasants, whom A. Young calls "the most ignorant set of men in the world." He should have considered, however, before he made this irrational assertion, that nature is not partial to any grade of society in the distribution of talents. Of consequence, that men brought up from their infancy in any branch of business, are far more likely to become well acquainted with it than men whose attention has been engrossed by other pursuits.

Here I beg leave to observe, that if a gentleman has reclaimed a small portion of waste land, even if it has been at an expense which has exceeded the value of the grounds after the improvement has been made, we seldom fail to hear much of it.

It would appear, however, that so little has been said or known in England, of the extensive and invaluable improvement made by the peasantry of Flanders and Brabant, that even Sir John seems to think, but not until after he had received Mr. Gillet's letter, "inquiry should be made into the state of the agriculture of those countries."

Now if this had been done before the system of extensive farming establishments was adopted in England, a very great deal of money which has been inconsiderately sunk, might have been saved; for it is evident, that the peasantry of Flanders and Brabant, could not have paid rent for the soil and supported themselves and their families, while these improvements were progressing in any other way than by the products of the soil; consequently this "prodigy of art" has been effected without any perceptible expense; while the improvements made in Britain, on a comparatively small and imperfect scale, have cost immense sums of money. The contrast between the present state of agriculture in Great Britain and that of Flanders and Brabant, is very great, as is the difference in the expense by which the improvements have been made. The proper inference to be drawn from these facts, is highly important to the interest of agriculture in this country; especially as too many have urged us to copy the most absurd and expensive errors that have been practised in England. In fact, it would appear that it matters not how absurd the practice may be, if it has been adopted in that country, though, if we had not been deceived by the glare of great crops, &c. we might have seen that the agriculture of Great Britain is far less profitable than that of any other nation known to us under the sun. The cause of this is evident. The profits to be derived by the agriculturist in other countries, depend solely on his own exertion and economy; consequently if his income be small, his mode of conducting his business, although it may be a bad one, must be such as will secure him a sufficient clear profit to cover the expense of his family. In England, however, the case is widely different. The farmers in that country have been bolstered up by government; therefore the strict rules of rural economy are by far too often, not only neglected, but also despised by them. The im-

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mense injury which has been done, however, to the soil in Virginia, and the improvement that has been effected by those who have judiciously cultivated small farms in Pennsylvania, ought to point out the course which should be pursued by us, when existing circumstances will admit us to walk in it.

Sir John Sinclair as clearly points out, as does Colonel Taylor, the great increased expense introduced by very extensive farming establishments, but at the same time fixes on a size by far too large to be profitably cultivated by any one single farmer. He says, "on the *whole* about three hundred Scotch, or three hundred and eighty-one English acres, is, in general, sufficient; and it has been remarked, that those who grasp at having farms of a *great extent, oftener lose than gain* by extending their concerns. Such a farm as three hundred acres may be laid off, so as not to extend beyond a reasonable distance from the farm house and offices. Where a greater quantity of ground is combined into one farm, the fields must be *extended*, and the expense of labour *increased*, from the *distance* between the *farm offices* and the *ulterior divisions*, by means of which a *greater establishment* will be required to *bring home the produce*, and to take out the *manure; much time* will also be *unprofitably consumed* in going to and returning from the *fields*, and in rainy weather the *grounds* will be *greatly cut up* by these operations; *much additional labour* will therefore be required from the necessity of taking lighter loads."*

It would seem that a very enterprising farmer might manage half this quantity of cleared ground advantageously. In common, however, one or two hundred statute acres would be better cultivated with less expense, in proportion to size, than a larger farm. Now, if Sir John be right as to the great increased expense necessarily following the increased size of farms, Arthur Young's very extensive establishment of fourteen hundred, must be very far wrong. But strange to tell, Sir John, whose better judgment seems to have been so captivated by the seemingly prosperous state of the agriculture of Britain, when his book was written, that he allows even much larger farms may be profitably cultivated, than Mr. Young considers the best and most "economical size."

To Colonel Taylor, Virginia is indebted for saving a considerable part of the great increased labour, introduced by a system of management similar to Arthur Young's supposed "economical" theory, which he boasts, seemingly for the purpose of obtaining all the credit due to it, was formed on "untrodden ground." It will be found, however, that his followers will have to retrace their gigantic steps. Likewise, that it will cost Britain an immense sum of money to repair, or make anew, the numerous buildings erected when the farms and farmers were smaller, and which his mistaken and inconsiderate theory, (formed by far too hastily, especially as he acknowledges it was fabricated on untrodden ground,) had devoted

* See his book on Sys. of Scotch Husbandry, vol. ii. pages 135, 136.

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to decay. The money that will be sunk by Britain, first and last, in this wild, visionary project, would be more than enough to reclaim all the waste lands in the country; especially if men, equal in industry and economy to the peasantry of Flanders and Brabant, were employed, and made to be interested in the work.

Virginia may boast, that in no part of Colonel Taylor's practice does any thing like ostentation or show appear. On the basis of genuine rural economy, he has laid the sure foundation of her rising suddenly from her ruins into prosperity and wealth.

Intent only on reducing the ruinous extra expense introduced by large farms, in the cheapest way that it could well be done, his sheds for sheltering his live stock through the winter are formed in the field next to be cultivated, by the simplest and least expensive means that can be devised. The skeleton, or temporary frames of his sheds, are made with fence rails, &c. without any labour spent in regularly framing them. The top, sides, &c. are enclosed by a thatch formed with corn tops, put on with incredible despatch; especially by Virginia negroes, who have been accustomed to build what are called fodder houses, on an extensive scale, by nearly the same simple and easy means by which the Colonel forms his sheds. These fodder houses are as tight and warm as any other houses can well be. The outside surface of the tops by which the sheds are covered, is the only part of the fodder exposed to the weather; consequently they are nearly as nutritive food for cattle, when the sheds are taken down in the spring, as they were before they were employed for thatches, provided they are well put on.

This gentleman considers the turnip an exhausting crop, affording but little nutriment. He, however, grows some of them, which perhaps every farmer ought to do, when his grounds cannot be got ready in time for a less exhausting and more nutritious fallow crop. He, however, estimates the pompion much more highly. In this I believe he is correct, as it would seem that any given space of ground occupied by this plant will yield more and better nutriment for live stock generally, than would do the same extent of soil employed in growing any of the roots, or other green crops cultivated by us for the same purpose.* Colonel Taylor, however, seems to consider it best not to grow more of any green crops than can be advantageously fed to his milch cows, while his beeves and hogs are fattening on them. By this judicious arrangement he has not to encounter the laborious task of frequently culling his pom-

* The seed costs nothing. The crop is gathered with much less labour than any of the green crops cultivated by us. The cultivation is also less laborious, for if they be planted near enough together a very close shade is soon formed. It should be recollected, however, that manuring only in the hill is a bad practice; especially if the soil be thin. This plant puts out roots at every joint in the vine which is in contact with the ground: therefore to obtain very extensive crops, those roots must be well fed. It will, however, yield a moderate crop, if planted on any grass lay which is well stored with the tops and roots of the grasses, without the application of farm yard manure.

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pions in order to feed those first which are sinking into decay. He also obtains more nutriment from his turnips by feeding them early. As he stacks up and covers his green crops with corn tops on the grounds where they are to be fed, much labour is saved in feeding these bulky articles.

He pens up his cattle at night through the summer, &c. on the grounds next to be cultivated; and this part of his economy is so managed that many acres are manured with the least possible loss.

He manages his hogs better than I have ever known it done, and so that little or no mischief is done by them. By feeding them well, and killing them much younger than is commonly done, his pork is good, and costs him far less than it generally does.

He drains extensive swamps, and by this means converts a surface very injurious to health into fertile meadows and fields.

He also gives much attention to live fences, a practice too much neglected, but of high moment in our older settlements, where timber is scarce.

I have before observed, that even the brushwood growing in the thickets, arising from bad cultivation and unpardonable neglect, is, by a very simple and cheap mode of management, reduced by him into valuable manure. While the gullies introduced by stupidity and neglect (in which this manure is employed by him) are filling up with the mould washed into them, and arrested by the brushwood, valuable crops are growing on them. Thus the double purpose of converting a disgrace to our country into fertile soil, and obtaining valuable crops, is accomplished. Nothing that is capable of being used as manure seems to escape the notice of this great economist; and almost every thing done by him seems to be accomplished with the least possible labour and expense. Neither labour, nor expense, however, appear to be grudged by him, when either will answer a valuable purpose. Of consequence he seems to act on a very extensive scale, in unison with the simple but wise economy of farming. Such gentlemen, I believe, are rare, therefore, when met with, should be the more highly prized.

I will conclude by observing, that as the tops of the clover, employed by Colonel Taylor, were stripped of the greater part of the nutritive matters contained in them, previously to their being ploughed under the soil in the winter, it was to the rich matters stored up in the roots of the plant, and to the action of gypsum, that this gentleman was principally indebted, for the rapid improvement made by him. As clover and gypsum, however, had been employed by many, without producing the same permanent and astonishing effect, as had clearly appeared in his practice, he seems to have been led to inquire whether other powerful auxiliaries had not acted in conjunction with them. As nothing but very high ridges, and ploughing in the tops of the clover, after they were dry, except persevering in a regular system of management, appeared different in his management from the general mode of employing clover as manure, he seems to have lost sight of the effects

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produced by perseverance alone, and introduces theories opposed to the economy of nature, and the enlightened reason of man, to prove that very high ridges, and ploughing in the tops of the clover, after they had been stripped of far the greater part of the food for plants, were powerful agents in his system of management; than which nothing can be more erroneous, as both were highly injurious to it. In this, however, the Colonel is by no means singular, as too many, among whom I may justly include myself, have considered the most injurious part of their management, the most important. This being the case, it certainly behoves the cultivator carefully to examine what is, and what is not, in unison with nature and reason, before any practice is adopted by him. By this plain and simple rule, the best practices may be amended, and bad ones entirely rejected by him.

It should, however, never be forgotten, that to Colonel Taylor solely belongs the honour of demonstrating, by actual practice, that poor grounds may be rapidly enriched, without the aid of farm yard manure, and at the same time so ordered, (by an economical system of management, which seems also to have originated principally in his practice,) that, in doing this, the crops and neat clear profit derived from them, will be so much increased beyond what they had previously been, as to favour the opinion, if the causes which produce these astonishing effects were not known, that the magic wand of fertility, had been waved by some supernatural power over the soil.

THE END.

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